Editorial

FOREMOST among the TV problems to be faced during the New Year is the necessity for technical training of servicemen.

It is exercising the minds of many people, not the least of whom are the set manufacturers themselves. They realise its essential importance. If the public through bitter experience begins to believe that TV sets are troublesome things which are always going wrong, and for which they cannot obtain adequate service, very serious sales resistance will be the result.

A TV set is an infinitely more complex piece of work than an ordinary radiogram. It has many more components—perhaps from 7 to 10 times as many. Even allowing for extra care in accepting materials at the factory, that means just so many more opportunities for troubles to occur.

The new techniques of TV as opposed to radio, and the use of circuitry with which the average serviceman is not familiar make some form of preliminary training absolutely essential.

A man with many years' experience finding faults in broadcast receivers can, with little more than a multi-meter and a soldering iron, get by fairly well except for the knotty problems, which, I fear, are too often skipped or avoided.

But this standard of service will be hopelessly inadequate for TV. For most honest servicemen, it will mean a complete refresher course, not only to take in the new TV techniques, but to reinforce their understanding of radio fundamentals which, even with the best of us, tend to become rusty over the years, and are replaced by guess-work and mental pictures of doubtful authenticity.

The technical colleges and schools report enormous interest in any and all courses dealing with TV. There is very evidence that plenty of servicemen realise what lies ahead and are willing to start in. The whole industry must interest itself by complete co-operation with seats of learning to assure that well founded technical education of suitable grades is available to all who are looking for it.

To every serviceman and technician who is facing up to the problem I would say—be honest with yourself about your experience and qualifications. Your livelihood and professional reputation are involved in this. Don't be afraid to admit to yourself where you are weak and to resolve to put in the necessary work and effort to learn.

Knowledge is power, and there is only one starting point—the beginning.

John Moyle

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RADIO TELEVISION & HOBBIES

A NATIONAL MAGAZINE OF RADIO, TELEVISION, HOBBIES AND POPULAR SCIENCE

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Vol. 17, No. 10

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OUR COVER PICTURE

432 black discs of silicon, encased in glass and aluminium, convert sunlight to electrical current which charges miniature storage batteries, mounted lower down on the telephone pole. Enough power is generated and stored by these means to power an 8-party rural telephone installed by the Bell Co. (See also page 3.)

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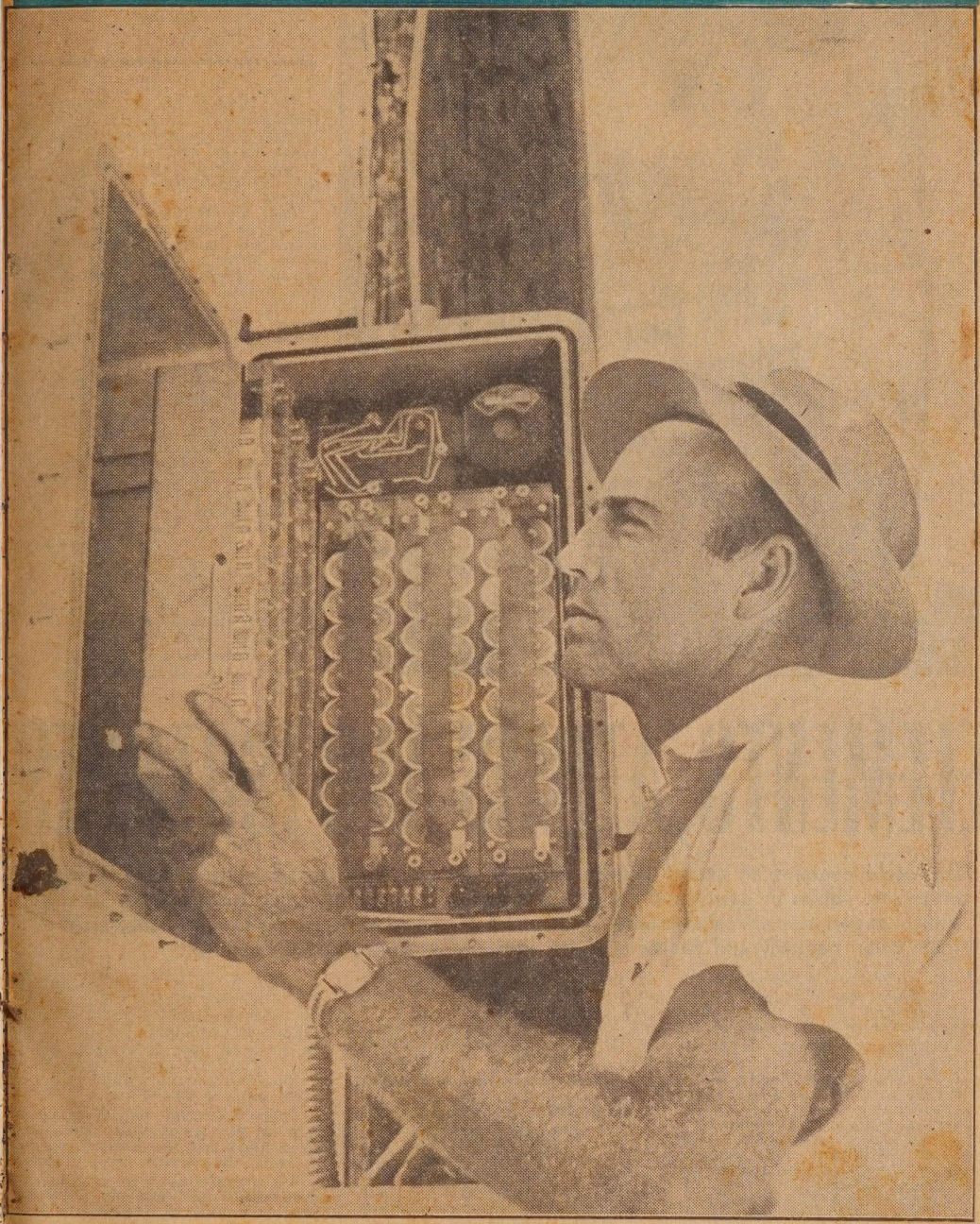
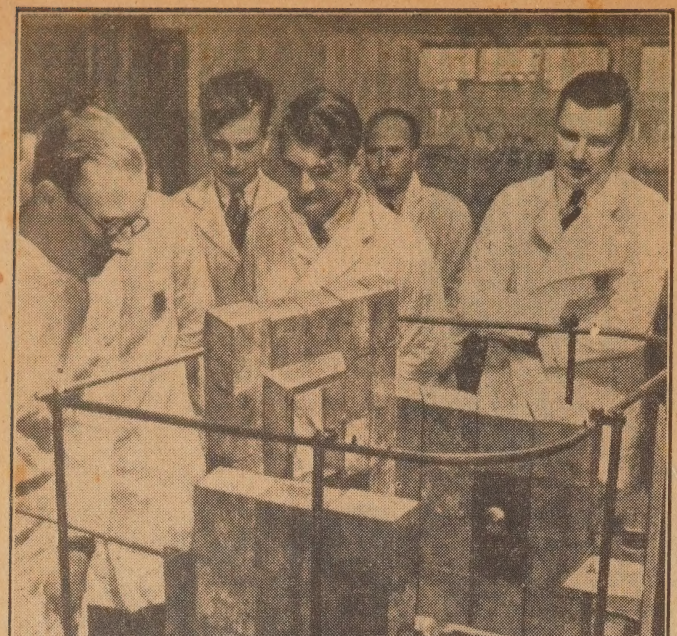
USA SOLAR TELEPHONE SERVICE



SOLAR TELEPHONE SERVICE—Bolted to the top of a 29 ft telephone pole, the solar battery is a tray of 432 black discs of silicon encased in glass and aluminium. The "battery" is really a converter of sunlight. Conventional storage batteries are installed at the base of the pole to catch excess electricity generated during the day to feed the telephone at night when the solar unit is dormant. There is no deterioration and theoretically the battery should last for ever. (See cover picture.)



Students attending a Radioactive Materials Course at Harwell. Here, Dr. J. G. Johnston is demonstrating how the chemical can be put into the isotope container by tongs. Two-inch thick lead bricks form a protective wall behind which workers can operate remote handling devices in safety.

ELEMENTS, ATOMS AND ISOTOPES

The world contains an almost infinite variety of materials, some of which are solids, while others are liquids or gases, and yet all are made up from a relatively small number of substances known as chemical elements. At present a hundred elements are known, eighty-eight of them occur naturally and twelve of these eighty-eight form 99 pc of all matter.

FOR each element there is a characteristic atomic weight which is determined on the basis that oxygen has an atomic weight of 16.

Sometimes the elements occur by themselves, as in the case of veins of gold and silver found filling up cracks in rocks; but, more often, two or more elements combine together to form a compound, such as water, which is made up of the elements hydrogen and oxygen; common salt is a combination of sodium and chlorine.

For many centuries it was appreciated that there must be a limit to the amount of subdivision which an element could undergo, and the term atom was used to describe these ultimate particles.

At the beginning of the 19th century Dalton put forward a theory in which he proposed that atoms of the same element were similar and equal in weight, and it was on this and four other postulates of Dalton's that modern chemistry has its foundations.

By Dr. S. OLIVER Ph.D., B.Sc.

Dr. Oliver was educated at Deacon's School, Peterborough, and Birmingham University. After graduating he carried out research work on recrystallisation in metals. Research on crystal growth followed at Bristol University. In 1942 he joined the Research and Development Branch of the U.K.A.E.A. Industrial Group.

The lightest of the elements hydrogen with an atomic weight slightly greater than one, and it wa suggested by Prout in 1813 that th atoms of the elements are all mad up of aggregations of hydroge atoms.

This would mean that all th atomic weights would be very near whole numbers; but while in man cases such as nitrogen (14.008 oxygen (16.00), chromium (52.01 and bismuth (209.00) this is tru in other cases like chlorine (35.46 copper (63.54), zinc (65.38) an platinum (195.23) it is obviously in correct.

A possible explanation of this dis crepancy would be that atoms o the same element are not all of th same weight, but this possibility wa discarded, since it disagreed wit Dalton's theory. A century was t pass before Prout was vindicated and one of Dalton's suggestions wa shown to be incorrect.

Later in the same century it wa pointed out by Mendeleeff that th chemical elements could be arrange in a periodic manner, such that ele ments with similar chemical pro perties were grouped together, an also that, with one or two excep tions, the elements were in order o increasing atomic weight.

This arrangement is known as th Periodic Table of the Chemical Ele ments.

Later work by Moseley on the x-ray spectra of the chemical ele ments showed that a serial number known as the atomic number, could be assigned to each element, start ing at hydrogen with atomic numbe 1 and ending, at this time, with ele ment number 92—uranium.

There were, at this stage, some gaps in this series which have now been filled and the series has been extended to element number 100.

What was equally interesting wa that when the elements were ar ranged in order of increasing atomic number, they were also in order of increasing atomic weight, with the same one or two exceptions which occur in the periodic table.

Despite the many advances and correlations which had taken place

scientists were puzzled by the one or two discrepancies in the periodic table, and also by the fact that so many of the elements did in fact have atomic weights, approximating so closely to integers.

The probability against this being due to pure chance was enormous, but no adequate explanation could be found.

This was the position at the beginning of the 20th century, and it might have remained like this for longer had further evidence not been provided by workers in the field of radioactivity.

In 1906 Boltwood discovered a new radioactive element, which he called ionium; this he said had chemical properties so much like those of thorium, that if the two were mixed together, it was impossible to separate them by any known chemical process.

In fact, other workers literally spent years trying to separate them with no success whatsoever, so that even the most sceptical were forced to admit that the chemical similarity between these two elements was of an order of magnitude entirely different from that ever before investigated.

A year later a second example followed, this time the two elements were mesothorium and radium. Then a third case was discovered in radium D and lead, and this time the atomic weights were determined and found to be different.

AN IMPORTANT STATEMENT

Now the hunt was up with a vengeance, and in 1910 Soddy put into words what many people had begun to suspect. In his report on radioactivity for that year he said:—

"Chemical homogeneity is no longer a guarantee that any supposed element is not a mixture of several of different atomic weights, or that any atomic weight is not merely a mean number. The constancy of the atomic weight, whatever the source of the material, is not a complete proof of homogeneity, for, as in the radio (active) elements, genetic relationships might have resulted in an initial constancy of proportion between the several individuals which no subsequent natural or artificial chemical process would be able to disturb. If this is the case, the absence of simple numerical relationships between the atomic weights becomes a matter of course rather than one of surprise."

At a later date, the need for a name for these substances which had the same chemical properties but different atomic weights became imperative, and Soddy proposed the word Isotopes.

The evidence for the existence of isotopes so far presented refers only to radioactive materials, and relies on the inability of the chemist to separate two "elements" prepared by different methods, and different in atomic weight, once they have been mixed together.

The complementary evidence came from the work initiated by J. J. Thompson on the properties of positive rays.

If an electric discharge is passed between two perforated metal plates (known as electrodes) in a tube of gas at a low pressure, streamers of light appear behind the perforations in the plate carrying the negative charge.

DEFLECTION DEPENDS ON MASS

These rays carry a positive electric charge, and so can be deflected by a magnetic or electric field, the amount of deflection by any given strength of field depending on the mass and the size of charge on the particles which make up the ray.

Now positive rays are made up of atoms which have been ionised (a process which is described later), so that if all the atoms from the same chemical element carry the same charge and have the same mass, they will all be deflected by exactly the same amount by any given magnetic field.

A diagram of the type of apparatus used in this experiment is shown in the accompanying sketch (Figure 1), and in this case, the amount of deflection is measured by recording the position of the deflected rays on a photographic plate.

Experiments were carried out in 1919 using neon as the discharge gas, and it was found that the atoms were not all deflected by the same amount, and that this chemical element was made up of two different kinds of atoms. That is to say, neon has two isotopes. (Later work has shown that there are in fact three isotopes of neon.)

Progress after this was rapid, and it was soon shown that the majority of the known elements were in fact mixtures of isotopes.

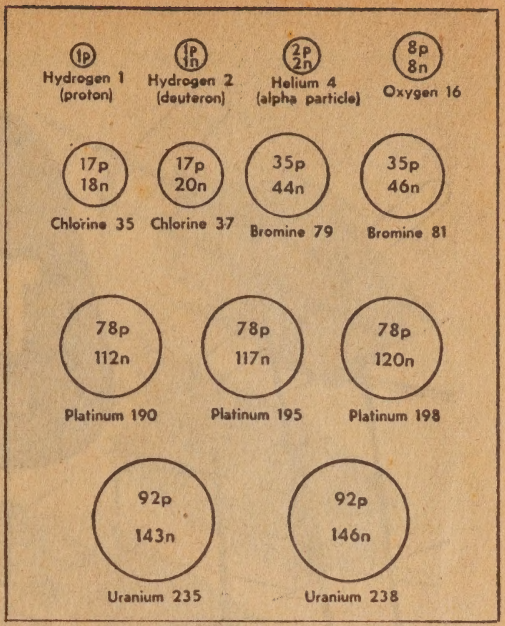


Fig. 2. Typical atomic nuclei. (p stands for proton and n for neutron). The terms deuteron and alpha particle are special names for the relevant nuclei.

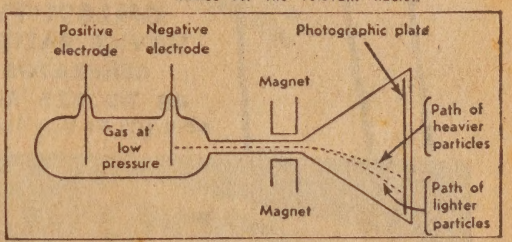


FIG. 1. Diagram of apparatus used for positive ray analysis.

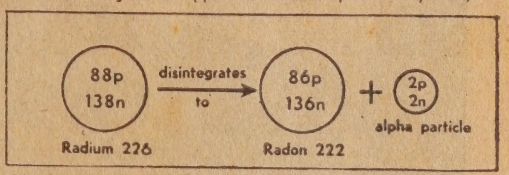


FIG. 3. An example of radioactive decay by alpha particle emission.

As the atomic weights of these isotopes were determined, it was found that the figures were very close indeed to whole numbers, and the suggestion made by Prout, that all atoms should have masses which are an integral number of multiples of the mass of the hydrogen atom, was found to be correct.

Chlorine, for example, with an atomic weight of 35.457, is a mixture of two isotopes with masses of 34.98 and 36.98, which occur in proportions of 75.4 pc and 24.6 pc respectively.

At the present time, approximately 300 naturally-occurring isotopes of the chemical elements have been discovered, and they are distinguished one from the other by the name of the chemical element and the mass number of the isotope.

This mass number is the integer to which the weight of the isotope approximates, so that the two types of chlorine atom are known as chlorine 35 and chlorine 37.

Atoms are extremely small and can be regarded as made up of a central nucleus and a number of "planetary" electrons.

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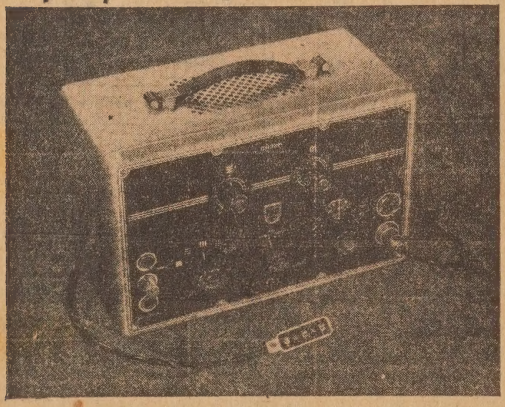

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All the atoms of any particular element have the same number of planetary electrons and protons, and it is the number of neutrons, in the nucleus which varies from the different isotopes of the element.

The two isotopes of chlorine, for example, have mass numbers of 35 and 37, and both types of atom have 17 protons in the nucleus, this being the atomic number of chlorine.

Since the proton and neutron both have unit mass, there must be 18 and 20 neutrons respectively in the two isotopes of this element. A selection of typical nuclei is shown in Figure 2.

The electrons surrounding the nucleus are grouped in orbits of different diameters, and it is the outermost group only which determines the major chemical properties of the atom.

If one or more of these outermost electrons is removed from an atom there is no longer the same number of planetary electrons as there are protons. The atom therefore has a positive electric charge and is said to be ionised.

It was to such ionised atoms, or ions, that reference was made when positive rays were discussed.

FORCES IN NUCLEUS

The protons in a nucleus repel one another since they all carry positive electric charges, but other attractive forces between both the protons and the neutrons more than counterbalance this repulsion.

The exact nature of the attractive forces is not known at present, but it is known that the particles in the nucleus are in constant rapid motion.

All the time protons and neutrons are jostling one another, and occasionally one of the particles will try to escape from the nucleus, but it will only succeed in doing so if it has a sufficiently high velocity.

For most of the chemical elements such an occurrence is virtually impossible, and in such cases the nucleus is said to be stable. In other cases, however, the nuclei are unstable, and every so often the nuclear forces are disposed in such a manner that the nucleus disintegrates.

Such spontaneous nuclear disintegration has been observed in several naturally-occurring atomic species, and the phenomenon has been given the name radioactivity.

When a radioactive nucleus disintegrates it does so by emitting either an alpha particle or a beta particle. As will be seen from Figure 2 an alpha particle is a helium nucleus, having a mass number of four and, since it contains two protons, carrying a positive charge of two units.

The mass number and atomic number (which it will be remembered is equal to the number of positive charges carried by the protons in the nucleus) of the atom are reduced by four and two respectively when an alpha particle is emitted.

The well-known radioactive element radium undergoes alpha particle disintegration and is thereby transformed into a gas, radon. This process is shown pictorially in Figure 3. It will be noticed that the mass numbers on the right-hand side of this equation add up to the mass number of radium and the atomic numbers do the same.

Beta-disintegration is fundamentally different, in that no protons or neutrons are emitted. In this case a neutron within the nucleus is transformed to a proton, and an electron plus a neutrino are ejected during the process.

The neutrino is a particle of even smaller mass than the electron, and it carries no electric charge; although it is of considerable interest to the nuclear physicists, we need say no more about it here.

It will be appreciated that the only change taking place within a nucleus when a beta particle is emitted is that one of the neutrons becomes a proton. Thus the mass number remains the same, but the atomic number is increased by one. An example of beta disintegration is given in Figure 4.

After the emission of an alpha or

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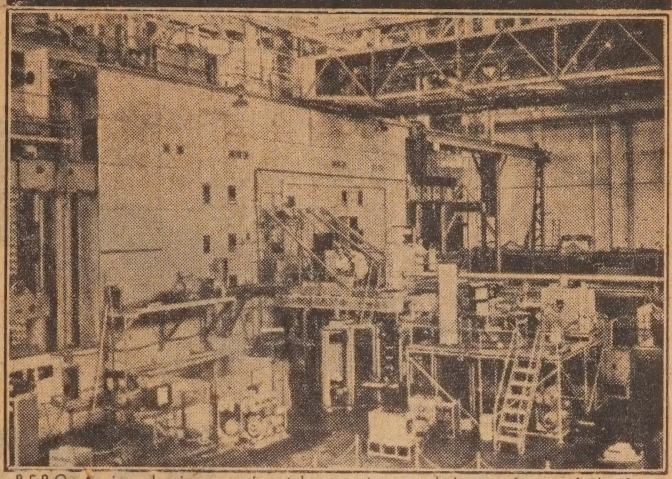

B.E.P.O. A view showing experimental apparatus crowded around one of the faces of the nuclear reactor, B.E.P.O., the atomic pile at the Atomic Energy Research Establishment.

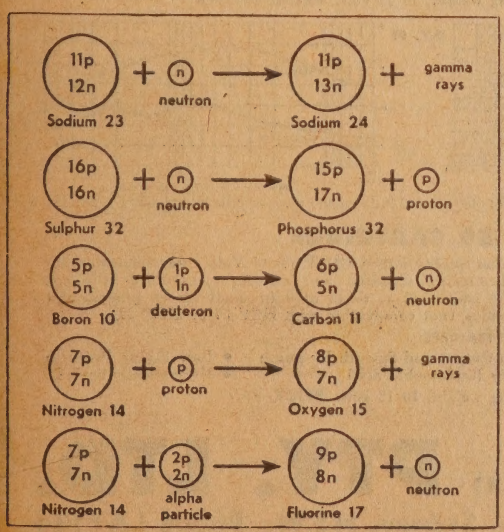

Fig. 5. Samples of artificial radio-isotopes.

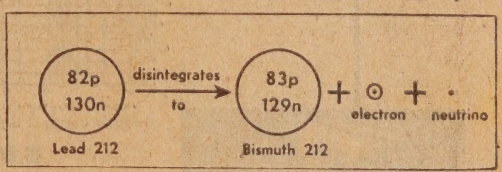

Fig. 4. An example of radioactive decay by beta particle emission.

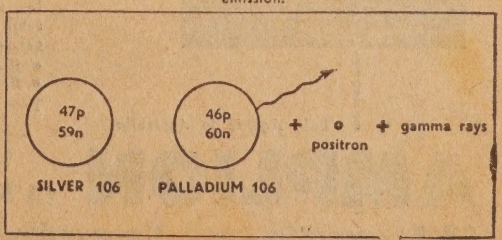

Fig. 6. Radioactive decay by positron emission.

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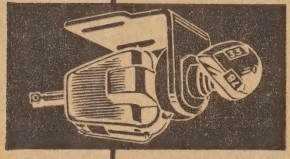

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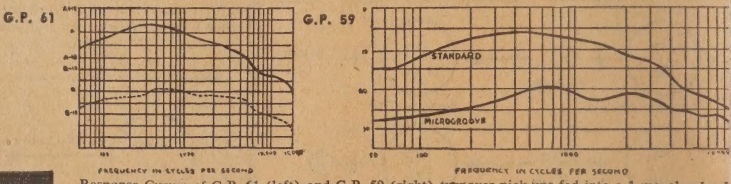
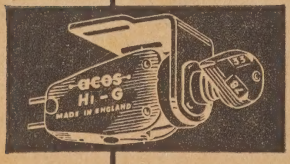


Response Curves of G.P. 61 (left) and G.P. 59 (right) turnover pick-ups fed into a 1 megohm load



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beta particle, the nucleus may be left in a state of abnormal motion. The return to normal of the nuclear particles is accompanied by the emission of gamma rays, which are a type of electro-magnetic radiation, similar to wireless waves or light, but of extremely short wavelength.

This gamma ray emission causes no change in either the atomic number or the mass number of the nucleus.

It is not possible to say how long any one atom will exist before it disintegrates, just as it is impossible to say at what age any given human being will die. It is possible, however, to make a statistical survey of the population and to quote death rates for different sections of the community; and, in exactly the same way, it is possible to quote a quite definite average lifetime for a given species of radioactive nuclei.

AVERAGE LIFE

Each species of unstable nucleus has its own characteristic average lifetime, which may range from a minute fraction of a second to thousands of millions of years.

The first feature of alpha, beta and gamma rays which makes them so useful is that they can be detected in extremely small concentrations.

In somes cases it is possible to detect amounts of only one-millionmillionth of a gram of an element, but the sensitivity depends very much on the energy of the radiation and varies markedly from one radioactive element to another.

The second feature is a radioactive isotope of the same element. Thus it is possible to "tag" a chemical element by means of a radioactive isotope of the same element, and so trace the path followed by the element in a chemical process.

The gamma rays emitted by some radioactive nuclei are capable of penetrating through considerable thicknesses of materials, and this, coupled with the fact that the position of a gamma ray can be recorded photographically, is the third useful property of radioactive materials.

On the other hand, too large a dose of one of these rays can cause serious damage to the tissues of the body; the quantity and quality of the radioactive radiation varies from one element to another, however, so that while some species can be handled for long periods with no ill-effects, other elements must be treated very carefully.

SHORT LIVED

Thus it will be appreciated that not all radioactive materials are suitable for a specific application.

Many radioactive isotopes cannot be used at all because of their extremely short lives; while the intensity of the radiation from an element with a long life may be too low for it to be useful.

For medical applications the radiation must not be so strong that it harms the patient; but when radiographing a piece of metal, the required intensity of the radiation may be very high indeed.

If the naturally-occurring radioisotopes were the only ones available, the application of this powerful tool would be very limited; but fortunately this is not the case.

There are two general methods for changing stable nuclei into unstable ones, and more than 700 artificial radioactive isotopes have been prepared.

The principle of the first technique is to bombard an element with rapidly-moving nuclear particles. Sometimes the bombarding particle sticks and produces heavier nucleus, in other cases it knocks a different type of particle out of the nucleus.

The first of these processes is accompanied by the emission of gamma rays. The bombarding particles for this process are either neutrons from a nuclear reactor, such as BEPO, the atomic pile at the Atomic Energy Research Establishment; or they are charged particles, such as protons, deuterons or alpha particles, which have been accelerated to high velocities in machines, such as the cyclotron.

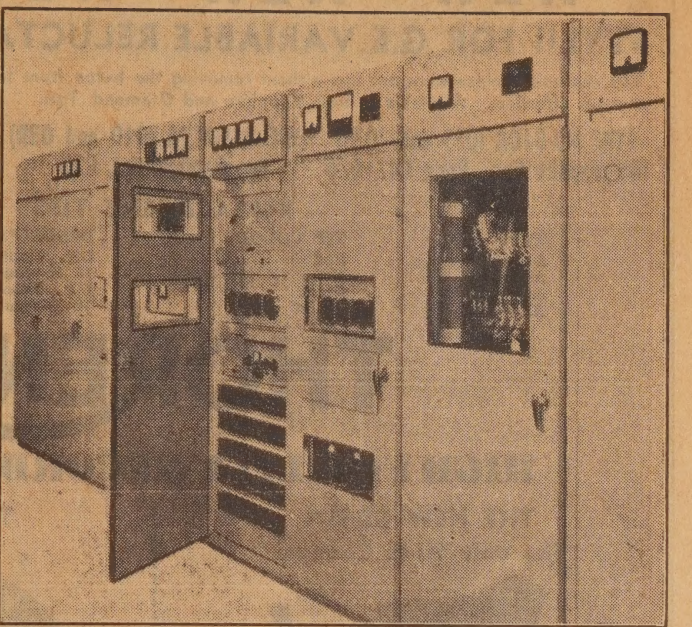
Typical examples of nuclei formed in this manner are shown in Figure 5.

The radio-isotopes produced by bombardment in the cyclotron may exhibit a type of radioactive disintegration not so far mentioned. This is the emission of a positron, which is a particle identical in mass to the electron, but carrying a positive instead of a negative electric charge.

An example of this is the radioisotope silver 106, which emits a positron and becomes palladium 106 (Figure 6). This illustrates the fact that this process results in the transformation in the nucleus of a proton to a neutron.

The second major source of artificial radio-isotopes is the fission of an atom, such as uranium or thorium. This process is the driving force behind the nuclear reactor and the atom-bomb; but the essential feature, so far as we are concerned, is that a uranium atom is broken into two smaller atoms.

XMITTERS FOR AUSTRALIAN TV



Television will come to a fifth continent this year, when Australia's first television stations are due for completion. Two Government-controlled stations, together with studio centres, are to be built at Sydney and Melbourne, and are expected to inaugurate the planned national television service before the end of the year.

Most of the equipment for the Sydney and Melbourne transmitting stations, including the transmitters themselves and the aerials, is to be provided by Marconi's Wireless Telegraph Company Ltd., under the terms of a contract worth more than £250,000, obtained through their Australian associates, Amalgamated Wireless (Australasia) Ltd.

Each of the stations will have an installation consisting of two main transmitters, (as pictured above) 18 KW vision and 4KW sound, with two smaller transmitters as standbys. The main vision transmitters to be installed are of the same type as those which Marconi's are supplying to the B.B.C. for their new Crystal Palace station. Like all the latest Marconi vision transmitters, those which are to be installed at Sydney and Melbourne are designed to handle N.T.S.C. type color transmissions as well as the normal black and white.

Marconi's have also been awarded an order for two complete camera channels, with ancillary equipment, which, it is understood, are to be used for training purposes at Sydney and Melbourne.

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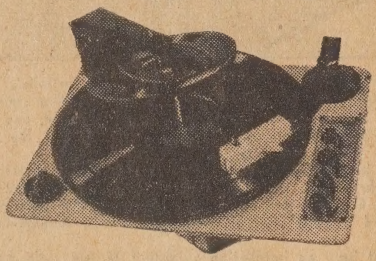

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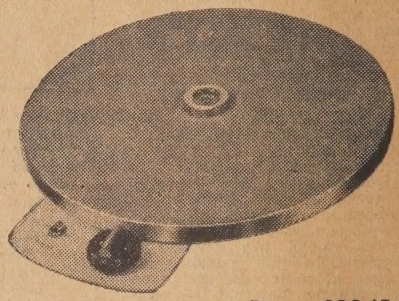

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DIGITAL COMPUTER FOR SYDNEY

It was recently announced that the N.S.W University of Technology are purchasing an electronic digital computer for installation in their new Electrical Engineering building at Kensington, Sydney.

THIS machine, to be known as "UTECOM", is being manufactured in England by The English Electric Company Limited and is a standard production model of the English electric type "Deuce" computer.

One of these units is already providing a commercial computing service for scientific and industrial bodies at a computing centre established at the company's Nelson Research Laboratories at Stafford. Two other identical units are now in service at the National Physical Laboratory, Teddington, and at the Royal Aircraft Establishment, Farnborough, England.

UTECOM, which will be the first "Deuce" computer to be installed outside the United Kingdom, is one of a further batch of machines now in production and is expected to be ready for service about April next.

The "Deuce" computer is designed to produce automatically the numerical solution of a large range of mathematical calculations at an extremely high speed. Many such calculations, which would occupy weeks or months, and some which could never be contemplated by traditional desk computation methods, can be solved on the "Deuce" in a matter of minutes.

The "Deuce" computers have already been used to solve a wide range of design problems in industry, including structural and aerodynamic problems in the design of the "Canberra" aircraft and the P1" supersonic fighter, problems of electron optics and filter design in the communication field, surge tank oscillations in hydro-electric power stations and critical speeds of a multispan shaft for the largest turbo alternator yet built in Britain.

The control console of the new digital computer. Computations will be possible on this equipment which would defy ordinary "desk" mathematics.

OTHER PROBLEMS

Other problems which may be solved by the computer include those associated with—

1. Stability of power systems.
2. Design of electrical apparatus.
3. Automatic control.
4. Design of nuclear reactors.
5. Aerial design and investigation.
6. Economics.
7. Statistics.
8. Commercial problems.

The University of Technology has a wide range of problems for solution by the computer, but time will be available for problems submitted by industrial firms, Government departments and research establishments. (Anyone interested in the use of the machine should contact Professor R. E. Vowels, Head of the School of Electrical Engineering, NSW University of Technology.)

Certain principles are common to all high-speed digital computers. They are capable of doing sequences of elementary operations, such as addition, subtraction, multiplication and division, together with some logical operations, of which the most important is the ability to proceed along one or two alternative paths at specified points in the calculations, depending on th results obtained up to these points.

To make effective use of the great speed available the machine must be supplied with the "program of instructions" which it is to carry out. This is coded into numerical form and is fed, together with numerical data on which it is to operate, into the machine's storage system.

BINARY SYSTEM

Internally, all operations are carried out in the binary scale of arithmetic to achieve maximum reliability and economy of equipment.

In the Deuce, numbers and instructions are represented by sequences of pulses at intervals of 1 microsecond. A train (or "word") of 32 such pulses is used to represent either a number (equivalent to 9 decimal digits with sign) or an instruction.

Two forms of storage are provided. The first is intimately associated with the computing circuits and includes 12 mercury delay lines each storing 32 words together with 10 shorter lines of various lengths which are used as accumulating registers, &c.

MAGNETIC DRUM

The second store of large capacity (8192 words—or more than a quarter of a million digits) is provided by a magnetic recording drum.

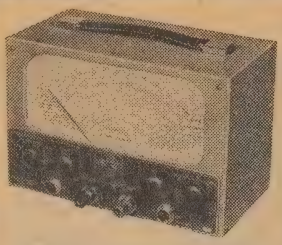
Information can be written on or read from 256 tracks by means of two sets of 16 heads, either of which can be moved into any of 16 positions by a high-speed shifting mechanism giving access to any track in 25 milliseconds.

Each "instruction word" specifies some transfer within the machine, and therefore determines the source (i.e., position in storage, &c.), from which a number is to be extracted, and the destination to which it is to be sent.

To achieve maximum speed optimum coding is used, i.e., each instruction specifies also the timing

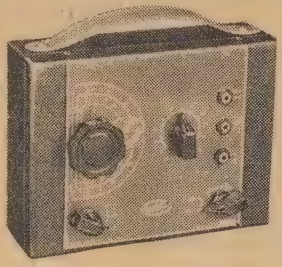
(Continued on Page 67)

UNIVERSITY service aids...



ELECTRONIC VOLTMETER —MODEL TVR-EV

This smartly styled University Electronic Voltmeter is designed for immediate use in Radio, TV, FM and Electronics. It offers many new outstanding features, and is a basic measuring instrument for every branch of electronics. It offers accurate measurement of DC voltages, AC voltages very wide resistance ranges and RF volts. Write for free leaflet.



OSCILLATOR—MODEL OK1

Available as complete kit of parts, with all constructional details clearly set out, or assembled. Covers all fundamental frequencies in the average receiver. Will give years of sterling service. Standard batteries are used, and each O.K.I. is supplied complete with Instruction Book. A free illustrated leaflet will be mailed on request.

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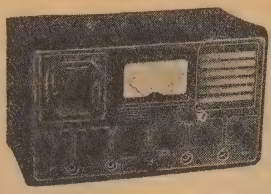
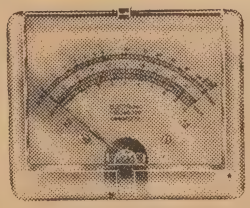


SIGNAL TRACER and V.T.V.M. —MODEL AST

Here is a Sensitive Signal Tracer with a Vacuum Tube Voltmeter which brings fault finding in service work to a stage where faults can be quickly located and analised. Brief specifications are: Power: 240 volts, 40 to 60 cycles. VTVM: 0/5, 0/25, 0/100, 0/500 Volts AC and DC. The signal tracer covers from 175 kilocycles to 18 megacycles. A leaflet is available on request.

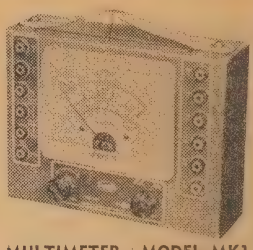
SHUNTS

A complete and comprehensive range of heavy duty shunts and light duty shunts are available. These vary from shunts in the microammeter range up to heavy duty shunts of thousands of amperes if necessary. Popular in radio testing are in the light duty "R" type shunts, which are small and easy to use and are adequately protected in a moulded bakelite tube. The ends of the shunt are brought out to pigtails which allow quick and easy mounting. Normally these milliampere shunts are supplied to match 0-1 Milliammeters rated at 100 millivolts and are supplied in standard ranges of 5, 10, 25, 50, 100, 250, 500 and 1,000 milliamperes. Standard values for ohm ranges are also available. Price: 9/- each, including Sales Tax.



4-INCH SQUARE METER

Model U-4: This all polystyrene meter pioneered by University Instruments provides the ultimate in appearance and accuracy. Available as an 0-1 milliammeter or any other type of standard range. It will enhance your equipment and yet will stand up to hard knocks as well as giving new beauty. This is one of the many meters in the University range.

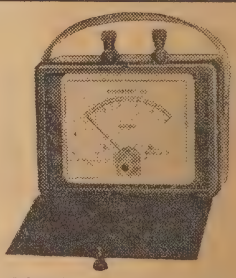


MULTIMETER—MODEL MK1

Has a wide range of AC and DC voltages up to 1000 volts and measures current in the range of 1, 10, 50 and 250 milliamperes, and resistance readings up to 100,000 ohms. Has U4 square meter with clear Multi-Scale. Supplied either as a kit or assembled. Assembly from the kit of parts is easy, wiring instructions and costructional details are given and photos and diagrams make the job easy. Write for details.

TEST LEADS

Type B2: These popular test leads are of moulded high quality bakelite and come in red and black pair. Standard tip jack plugs terminate one end and red and black braided wire of extra flexibility is provided Push-on alligator clips allow the leads to be attached permanently to circuits. 10/6 per pair, plus 12½ pc Sales Tax.

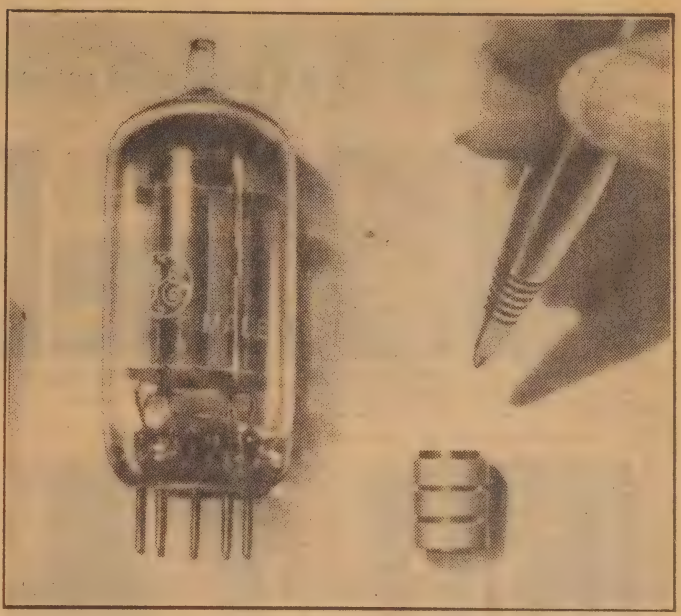


PORTABLE METER CASE MODEL B21

The case illustrated here is of hard moulded rubber, yet with sufficient resiliency to stand shocks and be unbreakable. It is supplied ready drilled to accommodate Models U4, W4 or R4 meter and is supplied with two terminals and carrying strap handle. A flap lid is fitted to the case so that the meter can be protected when not in use. Because of its insulating qualities this can be used for relatively high voltage equipment and provides a convenient method of employing portable meters for any industrial or electrical uses. Any range of meter can be fitted.

NEW HIGH TEMPERATURE VALVE

The General Electric Co., recently announced in USA the development of a tiny (about the size of a transistor) ceramic-titanium receiving tube capable of withstanding the extremely high temperatures and shock found in supersonic aircraft and missiles. The tiny valve may yet set a seal on super-miniaturisation of components for special purposes.



Ceramic receiving tube (at right) is dwarfed by conventional miniature tube (left).

ALTHOUGH the first tube-type available, the 6BY4, is aimed at the television-receiver market, it is planned to develop a full line of micro-miniature ceramic tube types for avionic and military electronic applications.

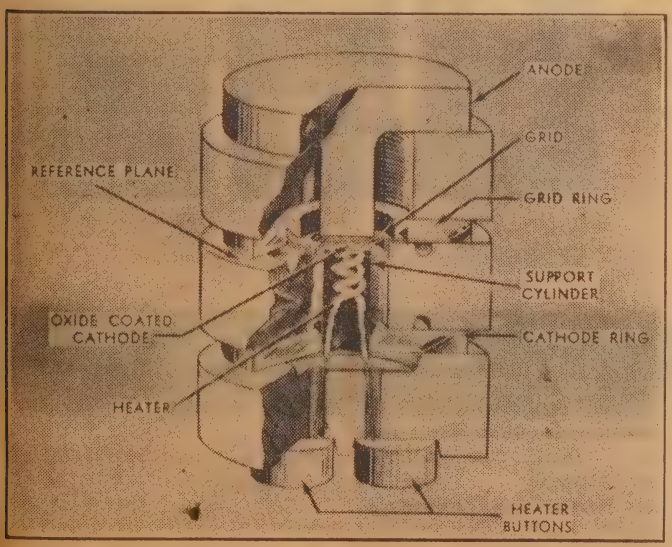
Some of these units could be available in 12 to 18 months.

The 6BY4 is a high-mu, low-noise triode capable of operating up to 900 mc. Samples have been operated successfully at 500C for more than 500 hr. Subjected to standard noise and microphonic tests, the 6BY4 has failed to yield any measurable microphonic output, according to the makers.

However, it is the 6BY4's high-gain, low-noise, high frequency characteristics which makes it attractive for use in UHF television tuners. The new tube is expected to cost TV manufacturers around two dollars. It is unlikely to be seen in Australia for some time to come.

In external appearance, the new tube resembles the stacked ceramic receiving tube developed by Eitel-McCullough. The GE version is considerably smaller than the Eimac tube, since it must operate at higher frequencies, and has a lower power rating.

The 6BY4 measures only 5-16in. in diameter and 3-8in long. However, future low-frequency, higher-power versions of the GE tube may be somewhat larger than the 6BY4.



Internal construction details of GE micro-miniature ceramic tube, type 6BY4.

The tube is built up from three ceramic spacers, which support and insulate two titanium "washers" and a titanium end-cap which functions as the tube's anode.

The titanium washers serve as a means of support and external electrical connection to the tube's electrodes.

The makers are secretive about the processes, developed by its research lab, which are used to weld the ceramic and titanium and to evacuate the tube. However, it is claimed that the seals remain air-tight at temperatures above 700C.

Titanium finds its first use in vacuum tubes for two very important reasons:

Easily de-gassed. GE discovered that titanium, unlike many other metals, need only be heated to 700C for a short period to release all internal gas.

Thereafter, increases or decreases in temperatures produce no further gassing. This is important because gas sealed into a vacuum tube, or released after sealing, causes deterioration of the cathode oxide coating, shortening tube life.

Excellent "gettering" properties. Titanium eliminates the need for conventional "getters" because it absorbs gases within the tube.

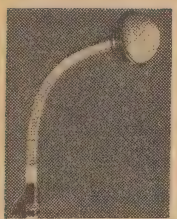
Many of the 6BY4's advantages

SWITCH TO AWA

PUBLIC ADDRESS MICROPHONES

A.W.A. Ronette Crystal Microphones and Accessories

AWA RONETTE



088/F. Filtercell, omni-directional, with flexible chromium plated suspension.

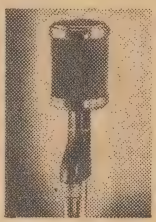
GS210 and GS210/L. Streamlined, chrome finish, filtercell, high or low impedance.

FF2-OV, FF2-P. "Fonofluid" turnover crystal pickup with alternate response characteristics.

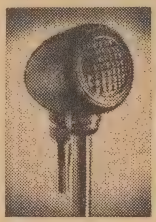
44. Hand or desk mounting, counter balanced base, ivory plastic housing

K407. Contact microphone for attachment to musical instruments — also used as throat microphone.

HM7. Hand or stand microphone, filtercell, robust diecast housing attractively finished.

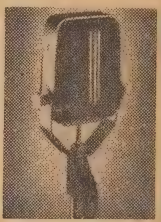


S742. Duo cell, omnidirectional, suitable for cable suspension.



B110. Plastic torpedo form.

R474. Studio type, 4 cell, omnidirectional.



R572 and R572/L. Studio type, duo cell, omnidirectional, high or low impedance.

RFC and RFC5/L. Single cell semi-directional, high or low impedance.

C53. Hand or stand, omnidirectional, black plastic housing and hand grip.

AWA Reslo

An extensive range of A.W.A. Ronette and Reslo microphones is available for all requirements.

RVA and RVH. High quality ribbon velocity available in high or low impedance.

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ALSO FROM LEADING WHOLESALERS

over its glass-envelope predecessors stem directly from its microminiature size and novel construction. For example:

Reduced inductance at very high frequencies stems from the short, direct connection to internal electrodes made possible by the titanium washers. This eliminates the long leads running from electrodes to base pins employed in conventional tubes.

Reduced coupling between cathode and plate results from effective shielding provided by the grid and its titanium support.

Reduced inter-electrode capacitance results from the use of extremely small electrodes.

Rapid electron transit time results from the extremely close electrode spacing. For example, when the tube is operating, spacing between grid and cathode is only 0.0006 in. However, this spacing may have to be increased for tubes designed to operate under vibration and shock encountered in aircraft and missiles.

The following figures are released on performance characteristics of the 6BY4, measured at 900 mc., in a grounded-grid circuit, with 10 mc. bandwidth.

Power gain: 15 db.

Noise factor: 8 db.

Amplification factor: 100.

Transconductance: 6000 micromhos.

Plate voltage: 200v.

Filament: 6.3v.

Future plans for avionic and military microminiature ceramic tubes include low and high-mu types, as well as power amplifiers, in both triode and multi-element types.

"Since the revolutionary development of the transistor, there has been a tendency in some quarters to assume that the vacuum tube is a dead duck. Other thoughtful persons have expressed concern that research and development on vacuum tubes might become neglected in favor of semiconductor reseacrh.

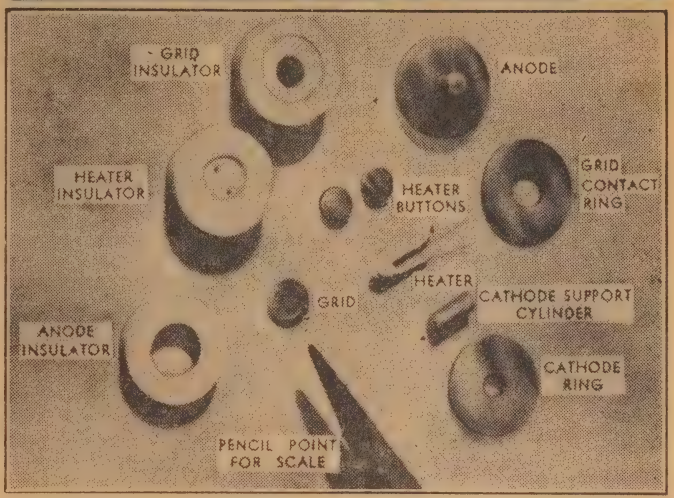
"But the remarkable achievement of miniature ceramic vacuum tubes, with their exceptional capabilities at microwave frequencies — and their phenomenal high-temperature tolerance—which the transistor cannot even approach, shows that the vacuum tube art is far from dead."—Dr. C. G. Suits, vice-president and director of research, General Electric.

Another project on the GE agenda is to develop mechanised assembly techniques and machines for fabricating its ceramic tubes, which at present must be assembled under microscopes.

Both from the standpoint of size and internal construction, the ceramic tube appears less easily adapted than the Eimac and Sylvania ceramic tubes to mechanised assembly.

However, from the standpoint of mechanised placement of the completed tube in printed circuit boards, it appears to have a very slight advantage over its two competitors.—From Aviation Week.

SMALL SIZE 6BY4 ELEMENTS



Small size elements in the 6BY4 is emphasised when placed alongside pencil-point.

TESTING THE WORLD'S BIGGEST JET

The advent of the very high-powered turbojet engine has given rise to many new problems, not the least of which is the creation of satisfactory testing facilities.

THE most powerful aero engine yet announced, the De Havilland Gyron, developed a thrust of 15,000lb (6.810 kg) during a 150-hour test last year. It is believed to have exceeded this figure since.

To test an engine like the Gyron, the makers had to produce a special test bed, providing the necessary facilities for measurement as well as provision to combat the terrific noise which it produces.

LARGE SILENCERS

Designed by the de Havilland Engine Company's Plant Department, the new engine test laboratory was constructed between January, 1954, and May, 1955, when a Gyron was first tested on it.

The test house is a tall, narrow structure which broadens at the end where the air intake is situated. From the other end a large circular exhaust duct divides into two outlet silencers which are the largest in use in England.

The detuners that finally direct the gases vertically upward have the effect of lowering the pitch of the exhaust note so that there is little, if any, aural indication that testing is in progress.

The shape and size of the exhaust ducts are influenced by the necessity of maintaining a one-way flow of air through the test bed. Should hot gas from the outlet find its way back to the intake and be put through the engine a second time, power would be affected. A difference in the intake temperature of only 1 degree C can cause a loss or gain of 100lb thrust at maximum rpm.

The engine is prepared for test, mounted on a special trolley and wheeled into the test house. The trolley is placed on a hydraulic lift which raises the engine six feet until it can be suspended by four ties" of steel tubes. When running, the engine is restrained longitudinally by pads which indicate the thrust generated.

Above the engine are two panels carrying more than 400 transmitter pipes for pressure readings, while alongside the engine there is an electrical panel through which 150 test connections are made.

SOUNDPROOF ROOM

A soundproofed control room overlooks the engine, and it says much for the design of the test house that only two men are needed to operate it.

Fuel comes in from four tanks, each of which holds more than 12,000 gallons. A motor drives three pumps, which can provide a maximum of 10,000 gallons an hour—the consumption of a Gyron fitted with afterburner.

The Gyron test bed has cost the de Havilland Enterprise some £140,000.

Don't imagine that synthetic fabrics are merely useful. This lovely Parisian ball gown is pure white chantilly lace, woven with acetate fibre and silk, and it created quite a stir in fashion circles.

SCIENCE MAKES NEW FABRICS

During recent years there has been great progress in the manufacture and finishing of new fibres for the making of clothing. Chemists and research scientists are hot on the trail of new and better materials with better characteristics and lower cost than those provided by nature.

by Calvin Walters

NEW plastic fibres have made their appearance and have come into extensive use.

New processes for the treatment of the old and new fibres have wrought important changes in the character of fabrics used for the manufacture of clothing and furnishings.

With the introduction of these new fibres and processes has come a host of new terms which give the advertisers something different to work on and the women something to fall for.

Now I don't suggest that all advertising is "poppycock", but it is really something for women to come home with a few pounds' worth of some dress material and try to soften hubby by telling him that the material will last for years because it is Sanforised, Tebelised, Puritised, Sanitised, Telosorbent, Baconised, Ellicoted, and so forth.

These terms are not of my own invention either, for they are standard terms used today to describe certain processes which render the material different in some way from what it was before. I will describe these terms later.

Two of the most outstanding fibres of today are Rayon and Nylon. Next to cotton, Rayon is the most popular of all fibres, with Nylon a close third together with wool.

There are four main methods of making Rayon, namely, the nitrocellulose process, the cuprammonium process, the viscose process and the acetate process.

CELLULOSE BASE

All of these use cellulose as the basic material, which is a constituent of plants. The difference in the processes lies in the method of conversion of the cellulose into the hard filaments called Rayon.

The first or nitrocellulose process was discovered by a chappie with the formidable name of Count Hilaire de Chardonnet.

He built his first "artificial silk" plant in 1884, using cellulose dissolved in alcohol and ether.

As the years went by, many improvements were thought up and the process was known as the nitrocellulose process.

In 1934 this process was more or less discontinued in favor of others more economical.

The three processes used today are:—

THE VISCOSE PROCESS. This uses wood pulp or cotton linters first soaked in caustic soda and treated with carbon bisulphide. It is then treated for a longer period in caustic soda which forms a viscous solution. This is forced through fine holes in a plate called a spinneret. The fine filament emerging from the spinneret is passed through a bath of sulphuric acid which hardens the filament into a thread ready to be woven into fabric.

THE CUPRAMMONIUM PROCESS. This uses cotton linters or wood pulp boiled in caustic soda and soda ash.

This is bleached with chlorine, washed and dried. It is then dissolved in a solution of copper and ammonia and the resulting solution forced through holes in a spinneret which are larger than the finished thread is to be.

As the thread passes through a

hardening bath of sulphuric acid it is stretched until it is the required size.

THE ACETATE PROCESS. Bleached cotton linters are first treated with acetic anhydride and glacial acetic acid and placed into cold water where it forms into white flakes. It is washed and dried and dissolved in acetone.

The solution is forced through a multiple hole spinneret, each thread passing through a hollow tube to a spindle. During its passage through the tube it is hardened by air and wound on to the spindle.

Of the three latter processes the viscose process is the most popular, with the cuprammonium process second.

In addition to the difference in the manufacture of the thread, the processes differ in the method of making the yarn.

NOT A STORY

The term "yarn" in this instance has nothing to do with the telling or making up of stories. It means that several filaments or fibres are twisted together into a larger composite thread, and this is called "yarn".

Thus collecting several filaments and spinning them together is called "spinning a yarn". This is the same term used when referring to a story teller who "spins a good yarn" but where lies the connection I cannot say.

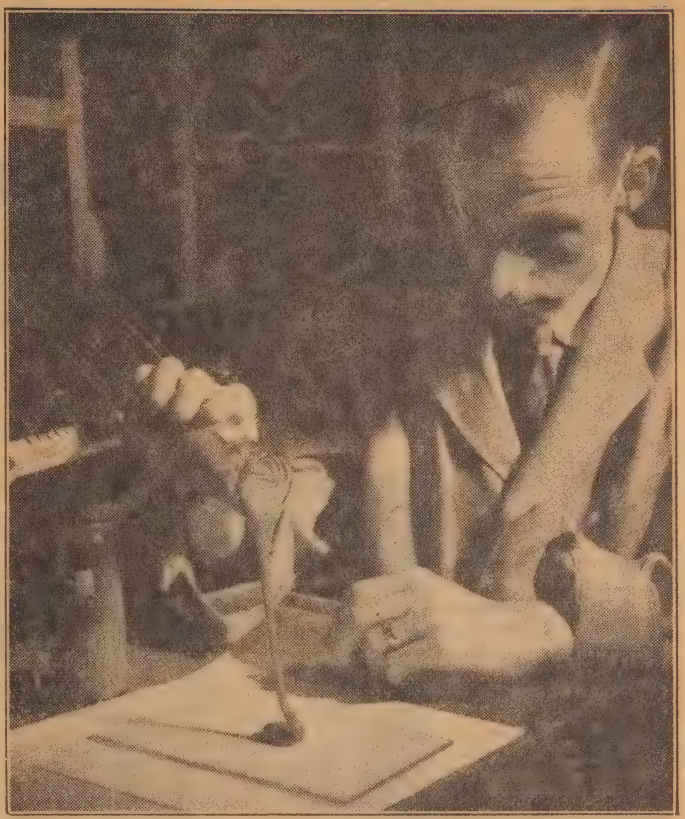
In the viscose process the solution is forced through a multiple hole spinneret and hardened in an acid bath before they stick together. All the filaments from the spinneret are twisted to make a yarn.

These are carried to a revolving spindle which twists the threads together while they are wound on another spool. The completed yarn is wound on cones.

In the cuprammonium process the fibres are stretched as they emerge from the spinneret. This increases the elasticity of the yarn. The filaments are twisted together as they emerge from the multiple hole spinneret as in the other processes.

LUSTRE

The methods outlined make a yarn with a lustre. This lustre can be varied. One method adds an oil which, by forming minute bubbles on the surface of the fibres, breaks up the smooth surface so that light cannot be reflected. Another method puts very fine particles of material into the spinning solution. These become part of the fibres and the resulting yarn is called pigment yarn.



Here is a technician examining a sample of spinning dope for cellulose content in a British Rayon factory. The dope is a mixture of the purified linters and chemical compounds of copper, ammonia and water.

Colored rayon is made by adding dye to the spinning solution. In the case of the viscose and cuprammonium process the same dyes are used as for cotton and linen.

Acetate rayon must be dyed with special dyes as those used for the other processes will not react with the acetate. The dyeing of acetate rayon is a tricky process. At least one blue rayon dye is notoriously unstable. It is affected by the nitrogen in the atmosphere and fades. This is called "gas fading".

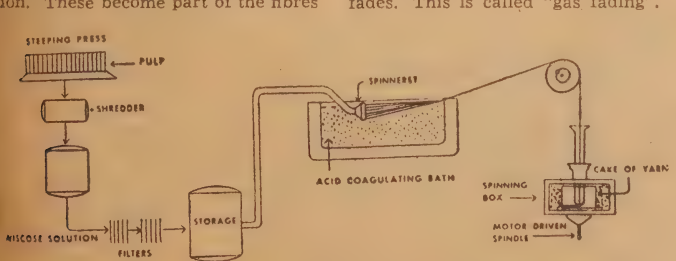
Sometimes acetate rayon is purposely mixed with either of the other two types and dyed after making into cloth with a dye which will not dye the acetate. Intricate effects can be obtained in this way because the acetate threads will be unaffected with the dye.

VARIETIES

Of course, there are many varieties of cloth which depend on the way the threads are twisted or whether they are long or short and so forth, but space does not permit further discussion of this matter.

The manufacture of nylon is a rather complicated process which cannot be fully dealt with here. To say that it is made of coal, air and water is somewhat true but you simply can't make nylon by mixing powdered coal, air and water together in a dish.

It would be nearer the mark to say that the coal tar derived from coal, the oxygen and nitrogen derived from the air, and the hydrogen from water are put through a series of complex chemical reactions to produce a solution which can be forced through spinnerets and



This diagram illustrates the production of viscose rayon yarn.

PUSH-PULL POWER

as only these

"Miniwatt" Twin Tetrodes

can deliver!

MINIWATT TYPE 5894 (QQE06/40)

A twin tetrode for wide band operation . . . widely accepted as standard for 420 Mc. service.

New ICAS Ratings up to 250 Mc. Now allowed 750-volt plate voltage for CW operation and 600-volt plate modulated. Designed for R.F. Amplifier, Modulator, Frequency Tripler use. Considerably reduced capacitances provide higher resonant frequencies. Single cathode and screen-grid construction result in low RF degeneration, therefore low drive required. Self neutralized over entire band. 4" high overall x $1\frac{3}{16}$" diameter.

	CCS	ICAS
144 Mc. input	120	150 watts
220 Mc. input	120	150 watts
420 Mc. input	100	120 watts

MINIWATT TYPE 6252 (QQE03/20)

Lower Input and Output Capacitances than any other comparable twin tetrode.

A natural for 420 Mc. use! Has been successfully operated as a frequency multiplier in the UHF TV band. Particularly suitable for low-drain mobile transmitters and multiplier chains. Only 3" high, with the same mechanical and electrical features that have placed the PHILIPS 5894 in the forefront as standard equipment at 400 Mc. or higher.

	CCS	ICAS
144 Mc. input	90	112 watts
220 Mc. input	90	112 watts
420 Mc. input	75	90 watts

A FULL RANGE OF TRANSMITTING TUBE MOUNTINGS AND ACCESSORIES ARE AVAILABLE

TEMPERATURE MEASUREMENT!

A range of "Tempilstick" crayons and "Tempilaq" paints are also available. These items solve many problems in measuring seal and glass temperatures.

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PVI8-55

hardened into a strong thread.

The main points in favor of nylon are, according to Wingate, Gillespie and Addison, as follows:—

Nylon is very elastic. This helps to explain the fact that nylon is resistant to wrinkling as elastic materials do not wrinkle as much as non-elastic materials. (You can't wrinkle a rubber sheet.)

Dry nylon filaments are stronger than any other filaments. They are twice as strong and half the weight of the same size aluminium wire. Thus nylon is durable.

It is not attacked by mildew or moths.

It can be dyed in any color with the same dyes as used for acetate rayon.

Nylon is smooth and retains little moisture. Hence it dries extremely quickly.

It is wear and tear resistant.

OTHER SYNTHETICS

In addition to nylon there are other fibres made from synthetic resin. This resin is made from coke, lime, water, salt and many other substances in a manner similar to the process used for nylon.

Among these synthetic resin fabrics are Vinyon, Orlon, Dacron, Saran, Velon, Dynel, Lastex and so forth.

Vinyon is strong both wet and dry, fire resistant, not attacked by acids, alkalies, bacteria or moths. It is very elastic but is sensitive to heat which is its chief fault.

Orlon is strong, dries rapidly, has a good silky lustre, is resistant to heat micro-organisms and mineral acids. It is resistant to ultra violet rays and therefore ideal for use in window curtains.

A common term in use to denote the thickness of reeled silk, filament rayon and nylon yarns is the word "Denier". This term is used without much thought as to its meaning except that it denotes thickness. All women know that a 15 denier stocking is thin and that a 60 denier is thick but that is about all.

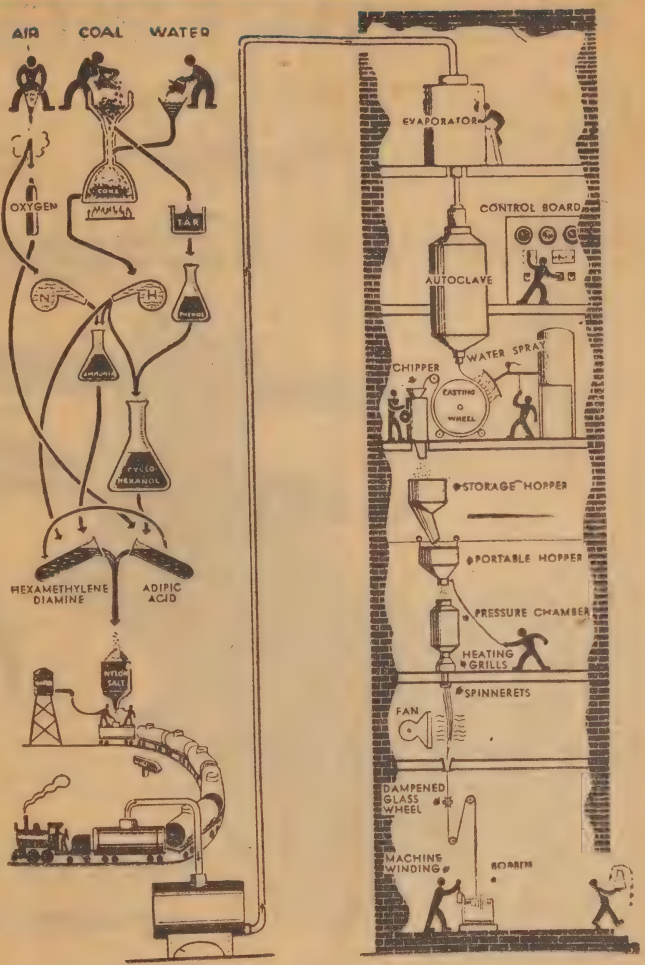
In the spinning factory the denier is determined by taking 450 metres of the yarn and weighing it. If it weighs exactly five centigrammes it is one denier thick.

Now 450 metres is a little over one-quarter of a mile and five centigrammes is approx 1/560 of an ounce. It will therefore be seen that one denier is a unit of extreme fineness.

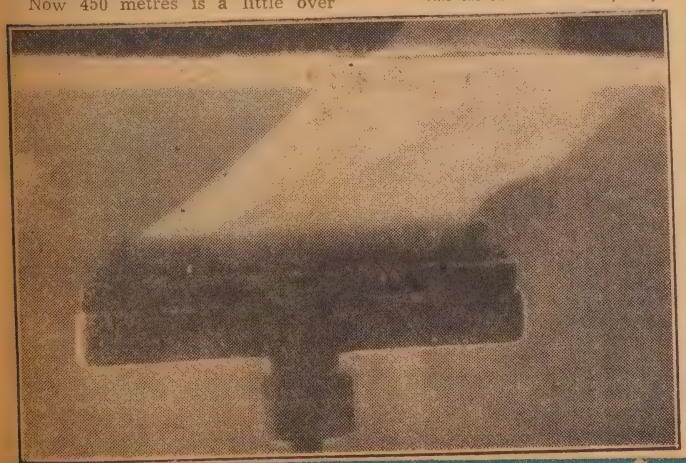
A length of thread 450 metres weighing 10 centigrammes is two denier and so on.

We will now deal with some of

(Continued on Page 113)



This sketch shows how nylon yarn is made (Dupont de Nemours Co.)



An untouched photograph showing a spinneret through which honey-like viscous casein is converted into fibre. To show the fibre at the exact moment when it emerged from the spinneret, the operation was simulated in a glass enclosed case, using a chemical solution more transparent than that in which the spinneret is normally immersed. The spinneret contains holes through which the viscous casein is forced under high pressure. The fibre is not a solid mass, as it appears to be, but thousands of different strands.

From Bach...

to Boogie...

TRADE MARK

SCOTCH BRAND **Magnetic Tape**

captures every sound

High notes, low notes—regardless of volume level—are taped right the first time by "SCOTCH" Brand Magnetic Tape.

That's why it's the international standard of the recording industry.

That's why it's the world's largest-selling Magnetic Tape.

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Technical Review

SILICON POWER RECTIFIERS HAVE MANY NEW FEATURES

Theory shows that silicon rectifiers can operate at current densities 1,000 times higher than those customary with copper-oxide and selenium rectifiers, and with much better forward and inverse characteristics.

THIS promise of improved practical devices has been realised in new silicon power rectifiers having alloy-type junctions. Present production of the silicon power rectifiers described here has been concentrated on units designed for currents of 100 mA to 1 A and inverse voltage of 100 to 600V.

The 400V cells, which thus withstand an inverse voltage of 135V rms each, can be operated directly from the 117V power line with either inductive or capacitive loads and filters.

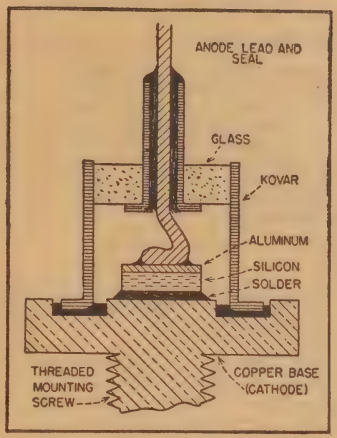
ALTERNATIVE RECTIFIERS

Dry-disc rectifier cells such as selenium are excellent for ratings up to about 36V rms. This is equivalent to about 100V DC inverse voltage. Such units must be considerably derated about 85 degrees C, however, and have short life under these conditions.

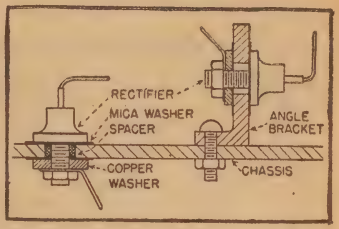
Customarily 5 to 6 cells are put in series to provide a 135V rms rectifier stack, and these have forward voltage drops 5 to 6 times the value of a single cell, with efficiencies of around 70 pc.

Germanium power rectifiers have shown many advantages at room temperature, where they have good forward and inverse characteristics. However, it is difficult to manufacture single cells with peak inverse voltages exceeding 65V rms. Germanium power rectifiers must be considerably derated above 55C, and generalyl canont operate above 75C at any power level.

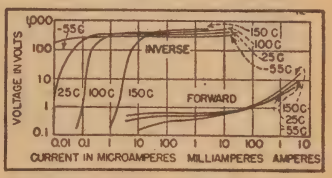
In contrast, the silicon rectifiers here described will handle useful power levels at 125C and will, with further development, be capable of operating at 200C. Other silicon rectifiers, not yet in quantity production, can operate at currents of hundreds of amperes or at voltages up to several thousand volts.



Cross section of new hermetically sealed silicon power rectifier cell. Diameter is only ½ inch.



Cell may be mounted directly on chassis as at left or on bracket

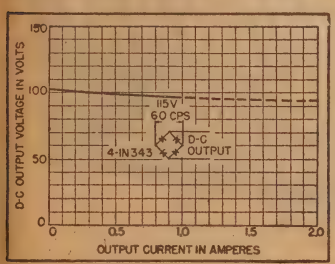


Voltage/Current characteristic of typical 1N341 unit at different temperatures.

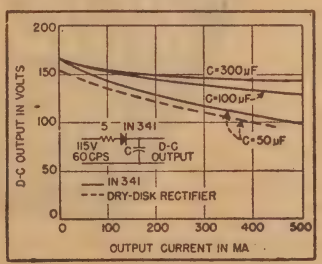
The heart of the new rectifier is a wafer of single-crystal silicon less than 1-8in suqare, having contacts fused to either side.

CONSTRUCTION

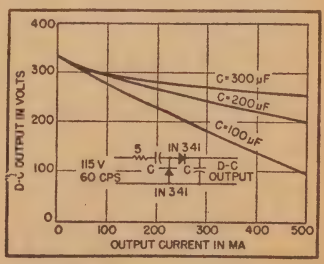
As shown in Fig. 1, one side of the silicon wafer has a fused aluminium alloy contact. This provides the semi-conducting barrier which determines the properties of this junction rectifier. A soldered contact is made to the other side of the silicon wafer; the sandwich is soldered to a copper base and



Output voltage of bridge circuit having resistive or inductive load.



Regulation characteristic of half-wave arrangement.



Regulation characteristic of voltage doubler using capacitor input.

ASK YOURSELF THESE IMPORTANT QUESTIONS BEFORE BUYING RECORD REPRODUCING EQUIPMENT

Will conventional methods of record reproduction match the quality of my modern recordings?

NO It is logical that for high fidelity record reproduction the Sound Console and Record Player be separated.

Speaker vibration is thus prevented from reaching the pick-up head, creating unwanted distortion to mar your record enjoyment.

Steane's HI-FIDELIGRAM has a separate Sound Console.

Will two speakers give better sound than one?

YES . . . The two-speaker sound console of the Hi-Fideligram System incorporates a crossover filter that effectively separates high and low notes to ensure that bass and treble frequencies are reproduced through separate speakers. The resulting tonal quality is excellent and without any trace of the distortion normally encountered when one speaker is asked to do the work of two. Sound Console is available in either Period Style Rosewood or Walnut finish or Blonde Contemporary Style.

Is any record player good enough?

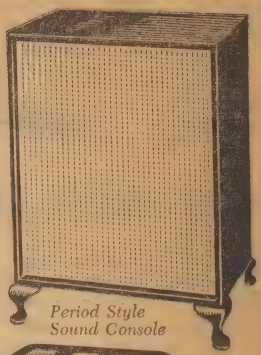
NO . . . The high quality record player of the HI-FIDELIGRAM System is another essential to high fidelity record reproduction. Special precautions have been taken to eliminate motor rumble, wow and flutter. Even needle scratch is eliminated from old recordings by a special inbuilt filter switch. The Record Player is mounted on a polished base to match speaker console.

Do I need a special amplifier?

YES . . . The HI-FIDELIGRAM Amplifier is not a radio amplifier. It has been specially designed for record reproduction. It has a power output of 10 watts, but even at this high output, distortion is less than 0.1%.

Price of complete HI-FIDELIGRAM System 150 gns.

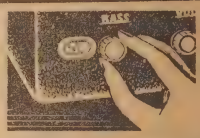
Separate Components: Amplifier 65 Gns., Sound Console £63/15/-, Record Player on base £25/10/-.



Period Style Sound Console

Amplifier

Record Player



★ VISI-AID INDICATORS

Acclaimed as a master aid in selection of correct tonal colours. These indicators enable the record enthusiast to select the correct tonal balance; accurate calibration allows simple visual compensation for the varying record characteristics encountered.

BRIEF SPECIFICATIONS

AMPLIFIER
Response: Flat within 1dB from 20 to 20,000 c/s.
Input: 500,000 ohms at 250 mV.
Signal to Noise Ratio: 70dB.
Tone Controls: Continuously variable bass and trebie, giving plus or minus 12dB at 30 c/s and 15,000 c/s.
Output Impedances: 2, 8, and 15 ohms.

RECORD PLAYER
Specially selected three speed turntable and PU on base.
Response: Connected directly to amplifier with tone controls set for flat response — within 3dB of R.I.A.A. characteristic from 30 to 10,000 c/s.
Needletip Weight: 5/16 oz.
Motor: Magnetically shielded asynchronous.

SPEAKER SYSTEM
Speakers: 12 inch low note and 6 inch high note speaker.
Impedance: 15 ohms.
Power Handling Capability: 15 watts.
Crossover frequency: 1,000 cycles.

Steanes HI-FIDELIGRAM HIGH FIDELITY RECORD PLAYBACK EQUIPMENT

Ask for a free home demonstration and full specifications from your nearest Radio Retailer or Music House or for free brochure contact

STEANE'S SOUND SYSTEMS PTY. LTD. 60 Miller Street, Melbourne — FJ 9149;
367 Kent Street, Sydney — BX 6388, BX 6389.

A46

an anode lead is attached to the aluminium.

A Kovar hermetic seal is placed over the copper base and the unit is sealed together. Hermetic sealing has been found preferable to plastic filling, as the slightest contamination can give leakage currents.

In fact, unless the unit is very carefully cleaned, washed and dried during processing, the minute leakage due to contamination would provide shorter life than the thousands of hours to which such units have already been subjected.

Since the copper base provides heat conduction in addition to serving as the cathode connection to the silicon, the base should be mounted firmly either on a chassis or a bracket.

This can be done by means of thin, large-area mica insulators, arranged as in Fig. 2. These mica washers offer a low resistance to the flow of heat but are excellent electrical insulators. Alternatively, a cooling fin may be mounted on the stud projecting from the copper base to provide for convection cooling.

POWER APPLICATIONS

The 1N341 silicon power rectifier has been designed for power applications in medium-power rectifiers and in magnetic amplifiers, as shown in Fig. 3. The forward characteristics are relatively unaffected by temperature in the usefuif medium-current and high-current ranges, where the voltage drop is a few volts at an ampere.

Only at very low currents is the effect of temperature appreciable. In most cases this amounts to a forward drop reduced by 22 mV for every 10C rise in temperature.

At currents in the 1 to 10-amp range, the forward characteristics vary among units. Some show a slight rise of forward resistance due to the increase of resistivity with increase in temperature.

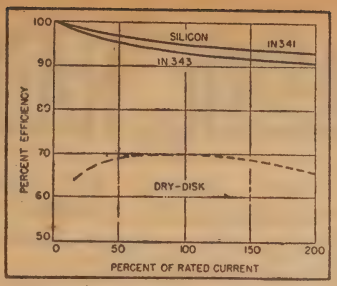
Others show a reduction of forward resistance due to an increase of injection depth at the junction at increased temperatures. No aging of the amount experienced with dry-disc type rectifiers has yet been found on these silicon rectifiers.

The inverse characteristics show clearly one outstanding feature of all silicon rectifiers, namely, the increase of breakdown voltage with increased temperature. This amounts to a 10 pc increase in breakdown voltage for a 100C increase in temperature, which is more than sufficient to allow the same peak inverse voltage ratings for a hot rectifier as for operating at room temperature.

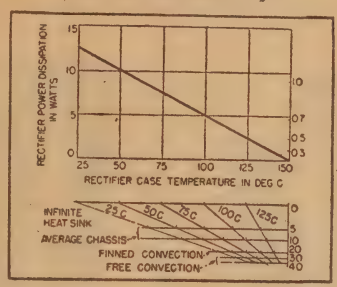
PEAK INVERSE RATING

The fact that the peak inverse voltage does not have to be reduced with increasing temperature is an important practical property of silicon power rectifiers. The absence of any appreciable inverse leakage current increases the possible output voltage in rectifier applications.

The inverse currents of good silicon devices are extremely small, but increase exponentially with temperature. The initial inverse currents at room temperature are the order of fractions of a microampere, so that even at 125C, many units show inverse currents less than 100 microamps at inverse voltages of several hundred volts. Such leakage



Variation of efficiency with rated current for full wave bridge.

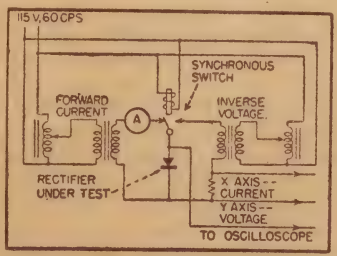


Curves below represent ambient temperature of heat sink.

currents are small enough to be completely negligible for rectifiers operating at a 100 to 1,000-mA level.

Certain types of silicon power rectifiers, such as the type 1N332, carry additional specifications on the averaged inverse current. Such specifications would be preferable for applications such as magnetic amplifiers, where maximum inverse current determines the limits of amplifier stability and gain.

With a bridge circuit comprising four type 1N343 300V rectifier cells



Production test circuit for silicon power rectifiers.

operating directly from 115V AC line, the no-load, unfiltered output voltage of 102V drops only to 97V with a 1-amp load and to 94V at 2 amp, as shown in Fig. 4. The peak voltage drop from the bridge is thus quite small, so that the regulation due to the rectifier bridge is excellent.

With practical filter circuits and transformers, however, the internal resistance of the transformer and filter choke would result in an additional voltage drop.

Of considerable interest for direct line voltage operation are the half-wave rectifier of Fig. 5 and the voltage doubler of Fig. 6, using type 1N341 units. In both cases the rectifier output approaches the theoretical ideal for a high-capacitance capacitor-input filter.

The internal resistance of these silicon power rectifiers is so low that a surge-limiting resistor (5 to 15 ohms) must be placed in series with the power source to reduce capacitor surge currents to safe values when the rectifier is switched on.

The electrical efficiency of silicon rectifiers is extremely high, even at low current levels. This is due to the almost complete absence of inverse dissipation at voltages below the peak inverse voltage. Figure 7 shows the efficiency of the rectifier in an unfiltered single-phase bridge circuit as a function of rated load current.

EFFICIENCY

Even at rated currents of the order of 1 amp where 100 watts of output power are supplied, the efficiency is still as high as 94 pc. This means that the units in the bridge circuit of Fig. 4 dissipate 6 watts, or 1.5 watts each, and it is necessary that this power be conducted through the copper base of the silicon unit without exceeding the maximum junction temperature of 150C.

For a unit of such small physical size, this requires that it be mounted on a good thermal conductor such as an aluminium chassis of reasonable area, or on a well-designed fin to provide adequate convection.

Various mounting alternatives have been developed to provide adequate cooling for such rectifiers. Properly mounted, a bridge circuit can supply loads of 100 watts even at ambient temperatures as high as 125C. Proper mounting of the silicon power rectifiers is a thermal problem which closely affects the electrical dissipation permissible with these rectifiers.

An idealised maximum power rating has been determined which refers to the rectifier mounted on what is called an infinite heat sink. This means a plate of large thermal conductivity held at the ambient temperature referred to by means of any satisfactory cooling method such as an air blast or a liquid.

TEMPERATURE CONSIDERATION

Under these conditions the rectifier will dissipate a power determined by the outside case temperature (the same as that of the infinite heat sink) and a maximum allowable junction temperature, in this case 150C.

Since the internal temperature drop of 1N341 silicon power rectifiers is well under 10 degrees per watt, a derating curve as shown in Fig. 8 is readily obtained. This curve shows the absolute maximum power dissipation permissible as a function of case temperature.

For use with practical dissipating structures, such as fins or brackets or direct connection to a chassis, the thermal power conducted away by such a mounting structure under the external ambient conditions will set the rectifier case temperature and therefore the internal dissipation allowable for each condition.

An L bracket used with mica

(Continued on Page 103)

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Compare these new features of our Hi-Fi nine valve D.W. radiogram chassis with dual triconed speakers and separate bass and treble boost.

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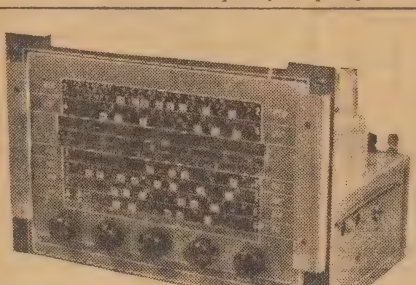
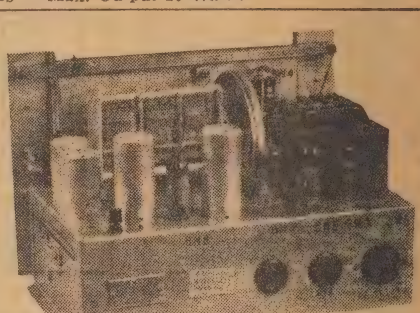
Frequency Response 40 to 13,000 Cycles — Max. Output 10 Watts.





NEW • Ultra modern circuit using nine high gain valves including "magic eye" tuning indicator. Permatuned iron cored coils and intermediates giving excellent interstate reception and a short wave range of 12,000 miles. All valves used are the new Philips nine pin innoval series.

NEW • Separate tone control stage using a twin triode (12AU7) with bass and treble controls in a Baxandall negative feed back tone control stage giving + or — 15db boost or cut at 50 cycles L.F. and 10,000 cycles H.F. combined with push-pull output with inverse feed-back gives you really high fidelity reproduction from your radio or favourite recordings.

NEW • Dual speaker combination using a heavy duty woofer (12in M.S.P. Jensen AU54 special) with twin coned 5in tweeter and cross-over network giving a frequency response of 46 to 13,000 cycles. Speakers are mounted coaxially making only one 11in mounting hole necessary.

NEW • Large calibrated edge-lit dial in perspex (11in x 7in) with main stations of each State in prominent type. Dial fitted with counterweight drive giving smooth tuning. Indicator lights are fitted showing which band is in operation. Dial can be supplied in cream or brown with matching knobs and escutcheon to suit blond or walnut finished cabinets.

NEW • Sensitive "magic eye" tuning indicator (EM80) making tuning simple and positive even on interstate and country stations.

All chassis are wired for the fitting of an F.M. tuner or tape recorder, special plug being provided on back of chassis also pick-up terminals and three-pin outlet for gramo. motor.
Power switch is fitted to volume control, radiogram switch combined with wave change switch. Audio end of set can be used with T.V. receiver if required.

ALL CHASSIS GUARANTEED FOR A PERIOD OF 6 MONTHS

A New 10 Valve Dual-Wave Radiogram Chassis

WITH BASS AND TREBLE BOOST

The ideal chassis for those difficult locations where reception is doubtful. Specifications as nine valve unit but with the addition of high gain tuned R.F. stage giving greater sensitivity and selectivity on both broadcast and short wave bands.

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NEW—7-VALVE WORLD-RANGE CHASSIS

WITH BASS AND TREBLE BOOST

SPECIFICATIONS AS NINE VALVE UNIT. BUT WITH SINGLE OUTPUT VALVE AND SINGLE 12in SPEAKER.

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WRITE FOR ILLUSTRATED BROCHURE GIVING FULL SPECIFICATIONS.

Large range of Radiogram and Console Cabinets from £12

RECORD PLAYERS AND CHANGERS

We have a complete range of 3-speed record playing equipment, including B.S.R. or Garrard Players, with turn-over crystal pick-ups or your choice of Garrard, Stromberg-Carlson, Collaro or the new B.S.R. 3-speed changer that will play 7, 10 or 12in records intermixed. All changers have turn-over Crystal pick-ups.

CLASSIC RADIO

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Haberfield, N.S.W.
Phone UA2145

TRANSISTORISED BATTERY PORTABLE PHONOGRAPH

The first completely transistorised portable phonograph, which plays 45 rpm records and operates from the power supplied by four 1½ volt dry cells, will be available from Philco (USA) soon. The new unit is shown in Fig. 1.

THREE fused-junction transistors are used in a two-stage audio amplifier circuit. The phono motor is a special 4-volt type. The phonograph will play up to 3000 standard 45 rpm records before the batteries, which are standard flashlight cells, require changing. Because of the low power drain, 150 hours of continuous operation is possible with this phonograph.

The new set has the smallest turntable motor of any phonograph on the market. It is a 4-volt motor weighing less than three ounces, and is approximately one-fifth the size of conventional motors. Power requirements for the motor are supplied by the four dry cells connected in series.

45 RPM ONLY

Actual operation voltage for proper motor speed is between 3.4 and 4 volts, which is obtained through a "speed control" potentiometer. This control is also used to compensate for any loss of voltage as original batteries grow old.

The motor itself is designed for 45 rpm record speed only, so that no complicated motor-to-turntable coupling system is necessary.

Among other features of this phonograph is the tone arm which serves as the "on-off" switch and automatically stops the turntable and turns off the set after each record is played, thereby helping to save the batteries. Of course, since transistors are used, no warm-up time is required. Records can be played with the lid closed.

The transistor phonograph uses a printed-wiring chassis with a 4-inch speaker.

The complete circuit is shown in Fig. 2 and consists of a transistor amplifier driver stage feeding two transistor stages in push-pull output. The transistors used are fused-junction types L5021 and L5022, manufactured by Philco.

The fused junction transistors are capable of relatively large power amplification for transistors, which explains the fact that quite a lot of volume is obtainable from this coupled to the push-pull output stage.

TRANSFORMER COUPLED

The crystal pickup feeds a high-output signal to the volume control from where it is transformer-coupled to the base connection of the first amplifier stage. This transistor, as well as the others, is employed in a grounded-emitter circuit. The output from the L5021 transistor is then high-impedance transformer-coupled to the push-pull output stage.

To obtain the required collector-base potential in the driver stage, the base is biased positively (as is also the emitter) by one battery while the collector is biased negatively by the other.

A voltage divider consisting of the 1000 ohm and 2700 ohm resistors (and the speaker voice coil) supplies the proper bias to the base. The emitter is supplied through the 220 ohm resistor. The 2700 ohm resistor also furnishes feedback from the output stage to the input of the driver stage. The 40 mfd capacitor in series with the 33 ohm resistor, from the emitter to the base of the first amplifier transistor, provides a low impedance path for the audio signal.

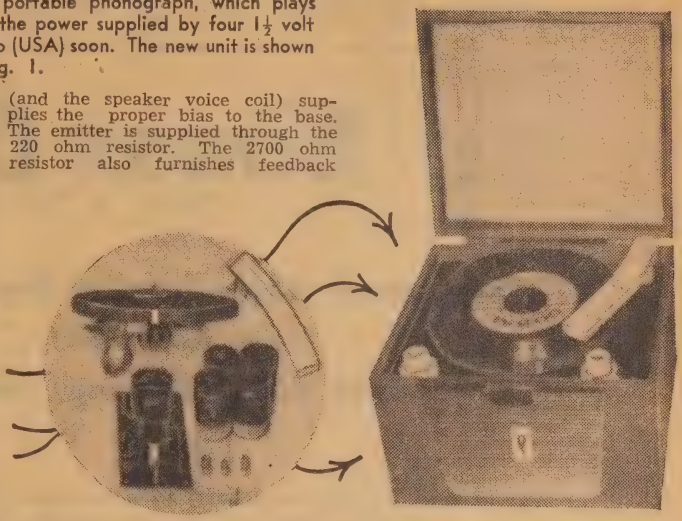

Fig. 1. The transistorised phonograph made by Philco, together with its various component parts. Four flashlight batteries furnish all of the power required for the DC motor and three transistors.

Since the output stage does not use complementary transistors, a two-winding secondary is used to supply signal to this stage rather than a centre-tapped single winding. A capacitor provides coupling for a common base for the audio signal, while isolating the two windings for DC biasing purposes. The output stage is low-impedance coupled to the voice coil of the speaker.

In servicing the amplifier, it is recommended that an oscilloscope be used in a conventional signal tracing procedure.

Two models of the transistorised phonograph are being made available by Philco, the TPA1 and TPA2. One is slightly larger than the other to permit the storing of thirty 45 rpm records in a special compartment in the cabinet.—(Radio and Television News.)

A new transistor for experimenters and amateurs has been announced in the US by GEC. The transistor, a stable and inexpensive unit, is coded 2N107 and is the first of a series of units intended exclusively for amateur use.

It is a P-N-P audio transistor of the fused junction type. Others in the new line will include P-N-P units for IF and RF applications, also of the fused junction type. The release of a P-N-P RF unit made by the new rate-grown process is also planned.

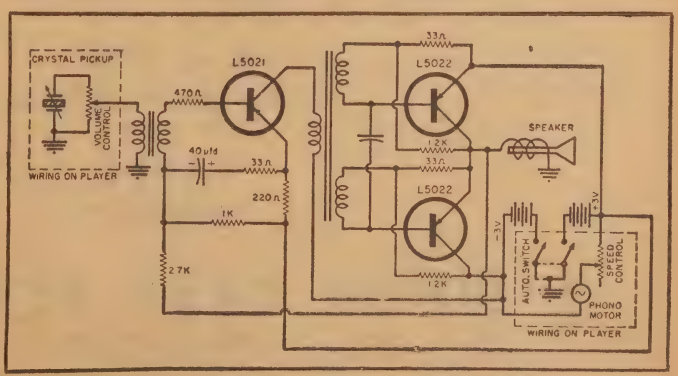

Fig. 2. Complete schematic diagram of the Philco transistorised phonograph.

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Tape Recorders
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We are also **VICTORIAN AGENTS** for
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acos

A COMPLETE RANGE

CRYSTAL MICROPHONES
MICROPHONE INSERTS

FOR EVERY PURPOSE

DESK or HAND MICROPHONE, MIC36

This Microphone is ideal for home recording and public address, etc. Response unexcelled for its size and price. The performance is not affected by vibration, shock or low frequency wind noise. Omni-directional frequency response substantially flat from 30 to 7,000 c.p.s. Recommended load resistance not less than 1 megohm, dependent on low frequency response. Can be supplied complete with switch and floor stand adaptor, as required, at a small extra cost. **PRICE, £6/18/6.**

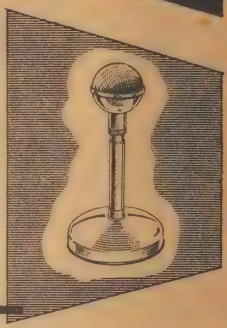
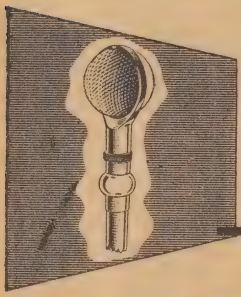


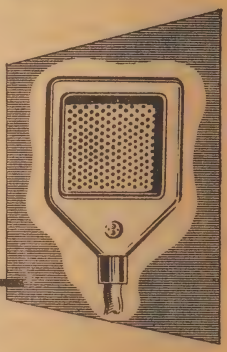
TABLE or STAND MICROPHONE, MIC22

This omni-directional Microphone is robust in construction, with a pleasing appearance. Vibration, shock or low frequency wind noise will not affect the performance. The low frequency cut-off is dependent on the load resistance. The cut-off is given by the equation, F = 80 divided by R, where F = c.p.s., R = megohms. An adaptor (floor mounting) is available at low extra cost. **PRICE, £9/18/6.**



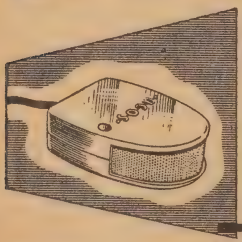
HIGH-QUALITY MICROPHONE, MIC16

This Microphone incorporates the world-famous floating crystal sound cell construction. Its fine performance is not affected by vibration or shock. The fidelity is not impaired by low frequency noise. **PRICE, £24/19/6.**



LAPEL MICROPHONE, MIC28

Designed to give freedom of movement, this Microphone is small and non-directional. Housed in a soft, moulded-rubber case, which gives protection against shock, it is provided with a pin at the rear of the case for pinning to the lapel. **PRICE, £5/19/6.**

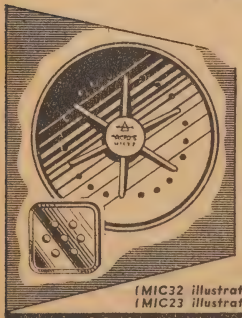


GENERAL PURPOSE, MIC35

The MIC35, is ideal for amateur transmitters, public address, etc. Housed in an attractive die-cast case, it features a high sensitivity and substanially flat characteristics. Provided with a built-in shunt resistance of 2 megohms, it will, when connected to the grid of the input valve, give a substantially flat response from 50 to 5,000 c.p.s. **PRICE, £2/15/-.**

HAND or DESK MICROPHONE, MIC33

This Microphone has been designed for the high quality public address and home recording field. High sensitivity and flat characteristics are obtained by a specially designed acoustic filter. Housed in an attractive plastic case with an unexcelled response for its size and price. Unaffected by vibration, shock or low frequency wind noise. Omni-directional frequency response substantially flat from 30 to 7,000 c.p.s. **PRICE, £6/18/6.**



CRYSTAL MICROPHONE INSERTS

These inserts are available in varying sizes, ranging from as small as ⅛ in. square to 1-⅛ in. round, with various thicknesses from 3/32 in. to 3/16 in. Suitable for every purpose, such as hearing aids, public address, tape recording, amateur broadcasting, etc., they have responses from 2,250 c.p.s. to 3,500 c.p.s. at -5 db to -30 db. Insert can be supplied with or without 10 meg. resistor as required.

MIC19/4 and MIC32, **£2/15/6;** all others, **£1/19/6.**

(MIC32 illustrated)
(MIC23 illustrated)

Sole Australian Agents:

AMPLION (A'sia) PTY. LTD. 88 Parramatta Road Camperdown, Sydney, N.S.W. - Phone LA 6124.

Victorian Distributors: DISTRIBUTORS CORPORATION, 403 Bourke Street, Melbourne.

NEWS AND VIEWS OF THE MONTH

Aerial prospecting

AIRBORNE electronic equipment is being used in mineral surveys over thousands of square miles in North Queensland.

They are scintillometers and a magnetometer "combing" northern mineral fields for possible deposits of valuable metals.

A Mines Department spokesman said the planes were carrying out surveys that would take ground parties years to accomplish.

"Big freeze"?

A WOMAN scientist believes many people thought to be frozen to death could be restored to life.

Stories of Rip Van Winkle may no longer be fantasy in 50 years' time.

The scientist is Dr. Audrey Smith who carried out experiments on her theory at the National Institute for Medical Research in London.

She has frozen golden hamsters and restored them to life an hour after their breathing and heartbeats stopped.

She says, "The stopping of heartbeats does not mean the animal is dead.

"Who knows that it might be true of humans?

"When pilots and seamen are in accidents in frozen areas it is often difficult to locate them.

"They might be exposed a long time before being found.

"Instead of giving them up for dead I think one might have a shot at resuscitation as we have done successfully with animals."

Animals Dr. Smith has frozen for long periods suffered no brain damage when thawed.

They were still alive and no older.

Dr. Smith says they can be stored in deep freeze indefinitely.

Her theory has been taken up by the US Navy researchers and the Arctic Health Research Laboratory of Alaska who are developing her tests further.

"Panic" jet crashes

MANY RAF fighter pilots are crashing because the strain of jet flying caused mental breakdowns.

RAF doctors recently revealed this in a report issued by the Royal Society of Medicine.

Pilots were crashing because their overtaxed brains gave way under the stress of trying to cope with a huge array of instruments while enduring the physical shock of flight near the speed of sound.

Some collapsed through panting so hard with fright that the blood supply to their brains became constricted.

Others remained conscious, but were so confused with panic they had no chance of keeping control of their planes.

A senior RAF doctor reported that the failure of mental processes ranged from minor forgetfulness to complete terror and inability to think.

An RAF research team was seeking methods of inducing panic under safe conditions on the ground in the hope of finding counter-measures.

More than 100 jet crashes occurred during 1955.

Challenge to wool

A SYNTHETIC fibre to challenge wool will be in production in Britain within two years.

It is one of the acrylic fibres derived from petroleum chemicals—known as "acrilan" in the US.

Small quantities of American staple had convinced British technicians that the fibre had a great future.

Scientists had already produced the fibre in experimental quantities in Britain, and some Lancashire spinners had had experience of spinning yarn from the new staple.

The US was using the fibre in blends with wool for slacks and suiting fabrics and in blends with cotton for acid-resisting work clothing.

Atomic houses

THE US Forest Products Laboratory and the Army Chemical Corps have jointly developed a new building board which is effective as a gas mask.

The board permits the passage of air and carbon dioxide, but absorbs radioactive dust, poisonous gases and germs.

Well-known wood chemists A. J. Stamm and H. Tarkow developed the new material. No details of the absorbent material have been released, as these are still on the secret list, but it is known that pilot production showed that the board can be made from almost any kind of wood with equipment little different from standard machinery for this type of work.

POPULAR SCIENCE QUIZ

Q. Where does the color come from on a color TV set?

A. The color on a color TV set comes from the specially constructed screen of the tube. Unlike black-and-white TV tubes, where the phosphor grains are distributed over the screen at random, color TV tubes use three phosphors, the grains of which are distributed over the screen in a regular pattern. The three phosphors give red, green and blue-violet light when excited by the electron beam.

In some tubes there are three electron guns, one for each color, others use only one gun, but in all tubes there is a special electrode behind the screen, which ensures that the right color grains are excited by the beam.

According to the signals sent out from the transmitter one or more grains are excited, depending on the color of the original scene, and the mixture of light coming from the grains makes up the shade of color required

Q. What is carrier-current radio?

A. Radio, or in this case more appropriately, wireless, normally does not require wire connection between transmitter and receiver, because the RF signal is radiated directly into space. However, there is a limitation to the number of transmitters that can be put on the air in any particular area, because each transmitter has to occupy a certain band of frequencies within the frequency spectrum.

For highly localised applications, such as camps, hospitals or universities, where neither a fully wired PA system nor a radio channel is practicable, "wired wireless" is a possible solution. This is only another name for carrier-current radio.

Instead of feeding a substantial RF signal to an aerial and radiating it, a weak signal is fed to some suitable existing wiring, such as telephone wiring, or the power mains. At the receiving end, the signal is taken off the wiring by a suitable "radio" receiver. A carrier frequency no higher than about 600 Kc is usually selected, to minimise direct radiation from the lines.

Q. Why does one get an electric shock when entering some buses or cars?

A. Electric shocks from buses or cars are mainly due to the fact that the body of the vehicle is well insulated from the ground by the rubber tyres. Friction between leather or plastic seat-covers and the passengers' clothing sets up quite substantial charges of static electricity, which have to remain on the body of the vehicle, since they cannot escape through the tyres.

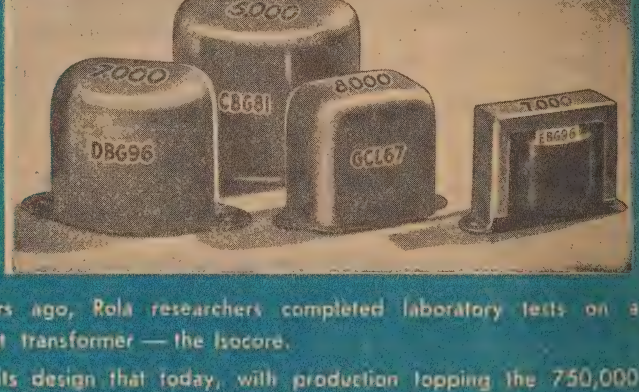
When a passenger sets up a conductive path between the metalwork and ground, the charge flows to earth through his body, resulting in an electric shock.

The shock can be prevented by allowing the charge to escape via a trailing chain or, in the more modern fashion, via a rubber strip, which has been made conductive by a special process.

They've Stood the Test of Time!

ROLA

LOUDSPEAKER & TV *Transformers*



Just over 10 years ago, Rola researchers completed laboratory tests on a revolutionary new output transformer — the Isocore.

So advanced was its design that today, with production topping the 750,000 mark, Rola Isocore transformers are still leaders in their field.

Each Rola loudspeaker transformer — both the Isocore which is moisture proof and protected against the corrosive effects of electrolytic action — and the widely used open types, is individually designed to provide best power output and frequency response from the valve with which it is to be used. Rola loudspeaker transformers are as famous as Rola loudspeakers.

And now to meet the needs of manufacturers, Rola has developed a whole series of the special types which are needed in television receivers. The design of these, too, reflects the skill and manufacturing precision associated with the Rola name.

ROLA COMPANY (AUST.) PTY. LTD

THE BOULEVARD, RICHMOND, VIC. JB 3921. 116 CLARENCE STREET, SYDNEY, N.S.W. BX3

Long distance TV

PERFECT television reception at 300 miles' range with ultra-high frequency waves is now becoming possible.

The present range limit set by the horizon is now 30-40 miles.

The new method is to bounce the high-frequency waves off the upper atmosphere layer.

This is how a "round the bend" television system would work—

• Big bowl-type reflector aerials would beam the TV waves into the sky.

• The waves, reflected from the troposphere, six miles up, would hit the earth about 300 miles from the aerial. Clear pictures had already been sent 200 miles.

Scientists evolved the system after special radio experiments connected with defence.

It could cut the number of TV stations needed to cover a country.

United States technicians had already worked out a relay route across the Atlantic.

Artificial rain

RAIN-MAKERS, winding up a six-week flying season in North Queensland, will not know if they have succeeded until two months' time.

The trials covered thousands of square miles to the north of the Gulf country.

The rain-makers spent four weeks at Cloncurry, then a fortnight at Cairns.

They experimented in mass seeding of large areas with silver iodide.

Success of their experiments will be gauged by rain recordings, many of which have still to come in.

They will be compared and analysed in detail against the rain team's seeding activities.

The silver iodide came from the plane as smoke.

It remained suspended in the air for long periods and could make rain fall hours later

Birds menace flying

CROWS and other larger birds frequenting aerodromes in France have proved a constant danger for jet aircraft, as they are often sucked into the intake ports of jet engines, causing the engine to cut off at the most crucial moment, just after the takeoff.

Different experiments to scare or eradicate the birds have not met with success, and it has been decided to try the ancient art of falconry as a measure against the birds.

Airport authorities are confident that the new—or old—method will be very successful.

Atoms in Germany

WEST GERMANY recently announced its intention to purchase two experimental atomic reactors from the USA. One of them, financed by the German Federal Government, will go into service at Karlsruhe; the other, financed by the Bavarian Government, will be installed at Munich.

Nobel prize-winner, Werner Heisberg, will head the research team operating the Munich reactor.

At the same time, the successors of the prewar IG Farben, Hoechst, announced their intention of installing a heavy water plant at Frankfurt.

Specify Microcap better in 6 important ways

MI

1 The AEE "Microcap" incorporates the modern technique of metallised paper in place of conventional alternate layers of paper and metal foil, thus producing light weight ultra-miniature, space-saving capacitors.

2 The Self-Healing feature in a very valuable characteristic which enables the "Microcap" capacitor to sustain accidental over voltage and provides an additional safety factor.

3 In the "Microcap" capacitor the wire pigtail leads are soldered directly to the capacitor unit in a manner that renders them free from intermittent contact, and the strength of the joint exceeds the tensile strength of the lead.

4 An insulation resistance exceeding 20,000 megohms for all values at working voltage of 20° C, is obtained on "Microcap" Type W99.

5 They have a power factor better than 1% at 1000 c/s at 20° C.

6 The "Micropac" W99 with all the BIG Features mentioned above offers stable long life in MINIATURE form and is available in a wide range of capacitances and voltages.

Microcap

METALLISED PAPER CAPACITORS

Write or call for leaflets giving technical details of "Microcap" W99 Metallised paper capacitors.

Manufactured in Australia under licence from A. H. Hunt (Capacitors) Ltd., England

AUSTRALASIAN ENGINEERING EQUIPMENT CO. PTY. LTD.

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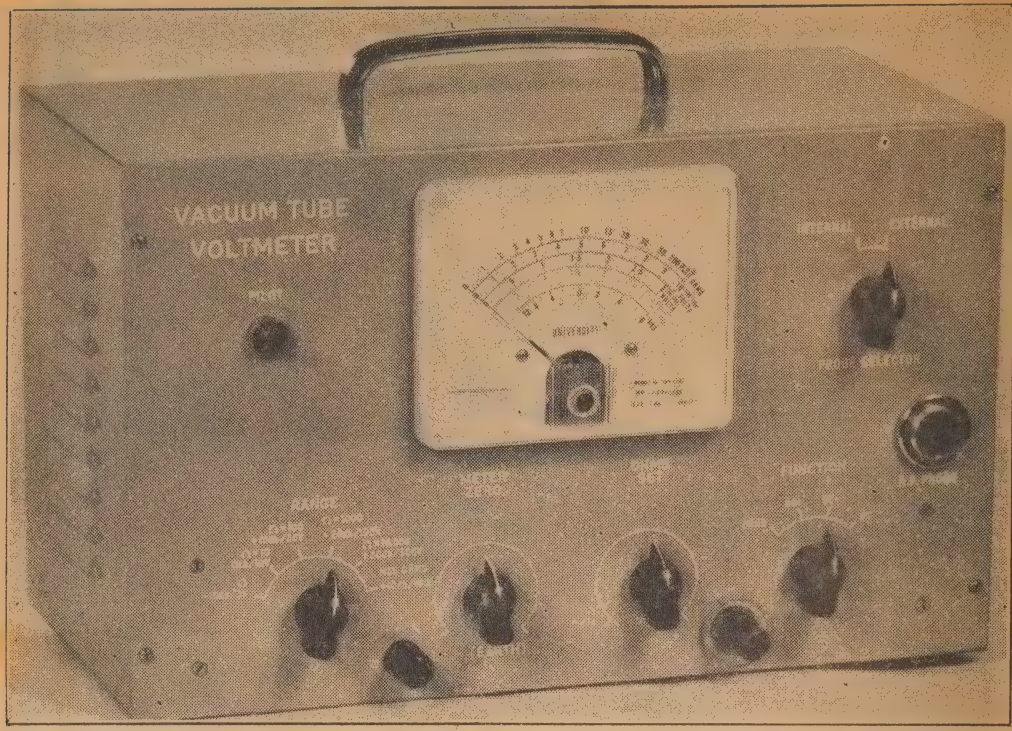


This photograph is large enough to allow you to read the panel lettering of the new vacuum voltmeter. The controls and operating procedure are practically the same as for an ordinary multi-range instrument.

BUILDING YOUR VT VOLTMETER

In last month's issue we discussed the design requirements for a modern vacuum tube voltmeter. In this issue we give the full constructional details of an instrument incorporating the various circuits and techniques discussed. You will find it to be a worthy companion instrument to our Audio Generator.

by Reg. Rawlings

THE instrument was designed to fit in the large instrument case which we used for the "Senior Signal Tracer" and the "Audio Signal Generator". The case measures 13in x 8in x 6¾in.

The case has a front panel 13in x 8in, which allows the various switches and controls to be sufficiently spaced for easy use. The general appearance of the finished instrument can be seen from the photograph at the head of this page.

TWO TERMINALS

All measurements are made from the same two terminals, a point which is a very definite advantage when the instrument is in use. Too many instruments, even those bearing the names of reputable manufacturers, require more concentration to be placed on the means of operating the instrument than on the circuit which it is being used to test.

To use the new instrument, it is only necessary to set the "Function" switch for the desired operation and the "Range" switch to the required range. It is little different in use from an ordinary multimeter.

The instrument is very stable in operation and the zero remains set for all the functions and range positions.

The circuit which, at first sight, may seem complicated is only the result of combining all the facilities that were discussed in last month's article. It is basically the circuit given in figure 7 of this previous article.

The valves have been numbered in the same way and the basic and practical circuit can be compared. The main addition in the practical circuit is the switching which is necessary to cover the various functions and ranges.

The "Function" switch is a three bank switch, each bank having two poles and four positions.

The two sections S2/a and S2/b change over the meter leads to enable the meter to read in the correct direction when the polarity of the input is changed. They also switch leads from the various sensitivity controls.

The "Range" switch is a five bank

switch, each bank having one pole and six positions.

The section S1/a switches the input of the balanced bridge circuit to the various points on the main voltage divider network. The section S1/b switches the opposite side of the bridge to the contact potential correction circuit, when the instrument is used to measure alternating voltages.

The section S1/c switches in the standard resistors for the ohms measuring circuit. The section S1/d modifies the sensitivity of the meter circuit on the 3, the 30 and the 300-volt ranges. We will not go into the reason for this just here, since this will be discussed later when the question of scales is considered.

The section S1/e switches in the various preset potentiometers on the AC ranges. It is necessary to modify the meter circuit sensitivity for each AC range, due to the non-linear characteristics of the diode which is used for the AC rectifier.

PROBE SWITCH

The switch S3 is a single bank switch having three poles each with two positions. Only two sections of this switch are used. These switch the circuit from the internal diode to an external diode, when it is desired to measure at high radio frequencies.

The design of a probe (or probes) to go with the instrument will be treated in a later issue.

The valve V5/V6 is the double diode used for rectification of the AC voltages and for balancing out the effects of contact potential.

To make easy the initial setting up of this balance a five megohm potentiometer is used in the circuit. This is a preset control and once this has been set it should not require further adjustment unless the valves in the instrument are changed.

The same remarks will apply to the other preset controls in the instrument. Although the number of these controls does at first seem to be great, it does make the job of setting up and calibrating the instrument very much easier.

The latter potentiometers are the standard wire-wound type with the shafts cut short and a screwdriver slot cut in the ends to facilitate adjustment.

POWER SUPPLY

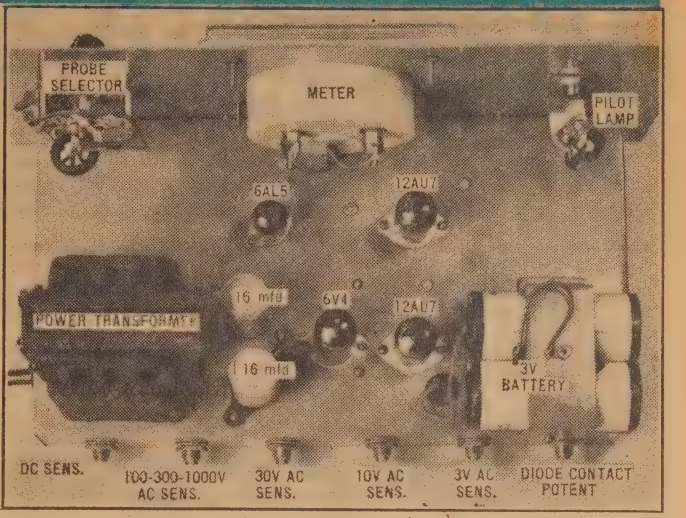
The power supply is conventional, except that it is arranged to give equal positive and negative output voltages with respect to chassis.

For this reason at least one of the chassis mounting electrolytics must be of the insulated type. The polarity of the lower of the two electrolytics must be watched, as this one has its positive terminal earthed. This can be seen clearly from the circuit diagram.

The power supply transformer is a standard type used for amplifiers and other equipment and should be obtainable from normal trade suppliers.

Most of the resistors in the instrument are of the high stability, cracked carbon type, which are slowly becoming available on the local market.

THE INSTRUMENT FROM ABOVE



The identification of calibating controls, valves and major chassis components will save you time in making the initial assembly.

We now come to the actual construction of the instrument.

The chassis is made of aluminium as well as the front panel; there is no special virtue in this, except that it is easier to work in the home workshop. The size of the chassis is 11½in x 6-3/8in x 2in deep.

This chassis does not reach right to the back, inside the case, as some space must be left for the preset controls. These are mounted on the rear apron of the chassis and project back from it by about ½in.

The general layout of the various components is shown in the photograph of the top of the chassis and the under-chassis view.

SWITCH POSITIONS

The positions of the various sections of the switches are marked so that the original layout can be duplicated as nearly as possible. The diagrams of the wiring of the switch wafers will also assist in wiring the

PARTS LIST

1 Instrument case 13in x 8in x 6¾in with engraved panel
1 Chassis 11½in x 6½in x 2in
1 0-1 mA meter approx 4½in x 3¾in, with special scale (University Model W4-207 or similar)
1 Power transformer 285 V-0-285 V 60 mA, 6.3 V and 5 V secondaries

VALVES
1-6AL5, 2-12AU7's and 1-6V4

HIGH STABILITY CARBON RESISTORS
1 10 meg 1 watt
1 7 meg 3 watt (2-2.5 meg 1 watt and 1-2.0 meg 1 watt)
2 4.7 meg 2 watt (1-2.2 meg 1 watt 1-2.5 meg 1 watt)
1 2.0 meg 1 watt
1 0.7 meg 1 watt (1-0.43 meg ½ watt, 1-0.27 meg ½ watt)
1 0.2 meg ½ watt
1 0.1 meg ½ watt
1 0.07 meg 1 watt (1-0.043 meg ½ watt, 1- 0.027 meg ½ watt)
4 0.047 meg 2 watt
1 0.03 meg ½ watt
1 10,000 ohm ½ watt
2 4,700 ohm ½ watt
1 1,000 ohm ½ watt
1 1,00 ohm ½ watt

RESISTORS
4 4.7 meg ½ watt
1 1.0 meg ½ watt
1 0.47 meg ½ watt
1 100 ohm 1 watt (see text)
1 10 ohm 1 watt (see text)

POTENTIOMETERS
1 5.0 meg linear
1 5,000 ohm WW
6 3,000 ohm WW

CAPACITORS
2 16 mfd 600 PV electrolytic
1 0.05 mfd 600 V paper
3 0.01 mfd mica

SWITCHES
1 5 bank, 1 pole, 6 position
1 3 bank, 2 pole, 4 position
1 1 bank, 3 pole, 2 position

SMALL COMPONENTS
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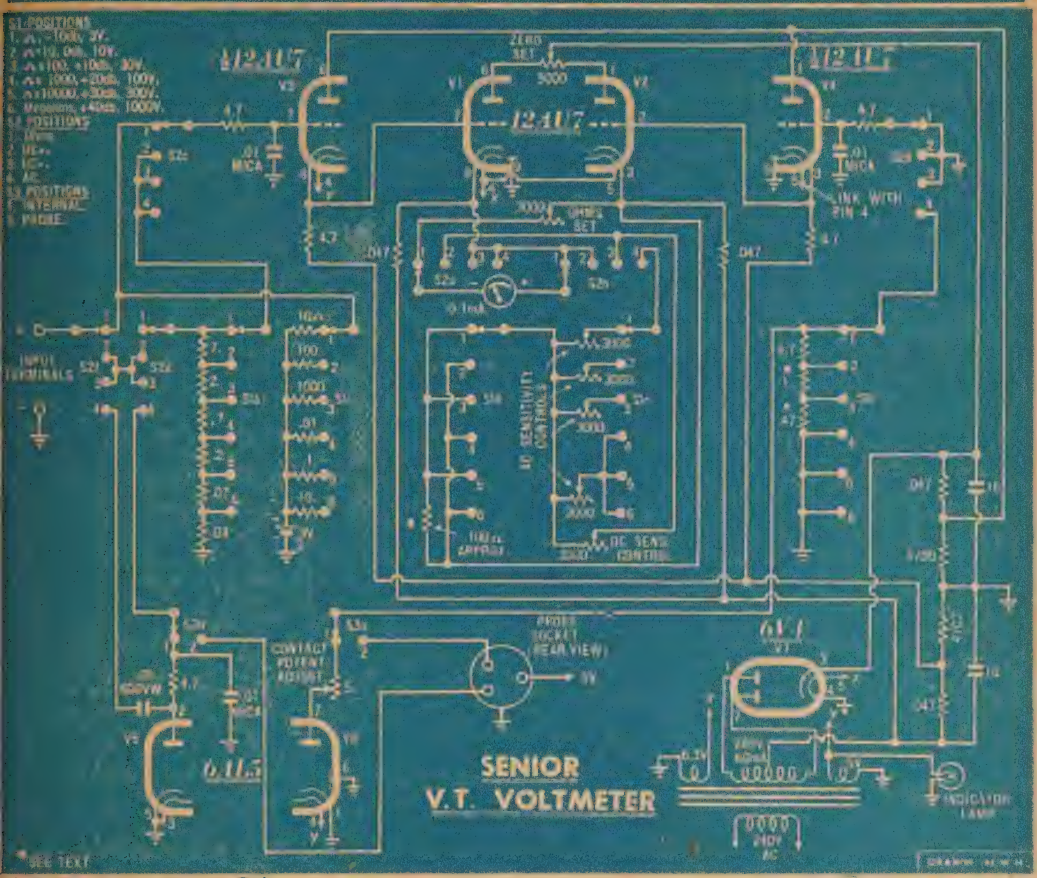


The overall circuit can be divided up into a number of separate sections, none of them very complex. You may care to study it in conjunction with the basic diagrams included in the article on page 80 of the December 1955 issue.

more difficult-to-get-at sections of these switches before the switch is mounted in the chassis.

For this instrument we used the normal bakelite type wafer switches and, provided that these are kept clean and free of flux during the wiring of the instrument, they should be quite satisfactory. Naturally enough, dirty and cracked wafers should not be used if the performance of the instrument is to be preserved.

The valve holders used were of the mica filled type and the direction in which they are mounted can been seen from the under-chassis photograph.

ANCHOR POINTS

Where stand-off insulators were necessary for anchoring components, the ceramic type were used. These are conveniently mounted by a single hole and take up very little chassis space.

In some parts of the circuit, it was necessary to use two resistors to make the desired value. This did not help with the layout, particularly on the range switch. However, with a little forethought, it is possible to fit all the resistors in.

Individual constructors will have to do their best to obtain resistors of the correct value, in order to minimise such layout problems.

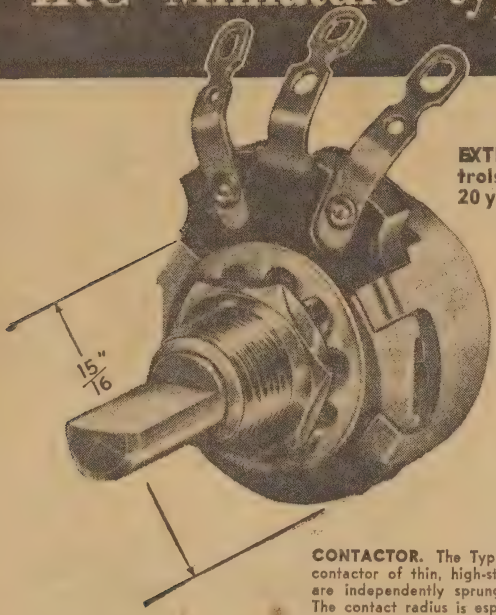
There is one exception to the ideal of one resistor for one value, namely where the voltage across a resistor is particularly high. This has nothing to do with the wattage rating of the resistor for, although the dissipation in the resistor may be well below the maximum permitted, there is in addition a limit to the voltage that can be put across any given resistor.

This maximum voltage will vary with the LENGTH of the resistor and its type. In the case of the high stability resistors that we used, the rated value varies from 350 volts for the half-watt size to 750 volts for the two-watt size.

The 47,000 ohm resistors in the power supply and those used for the cathode resistors of the meter circuit have a considerable amount of

The 0-3 scale does not cover the full deflection angle of the meter movement in order that the consecutive voltage scales can be separated by exactly 10 db. This is discussed in the text.

New IRC Miniature type Q Control



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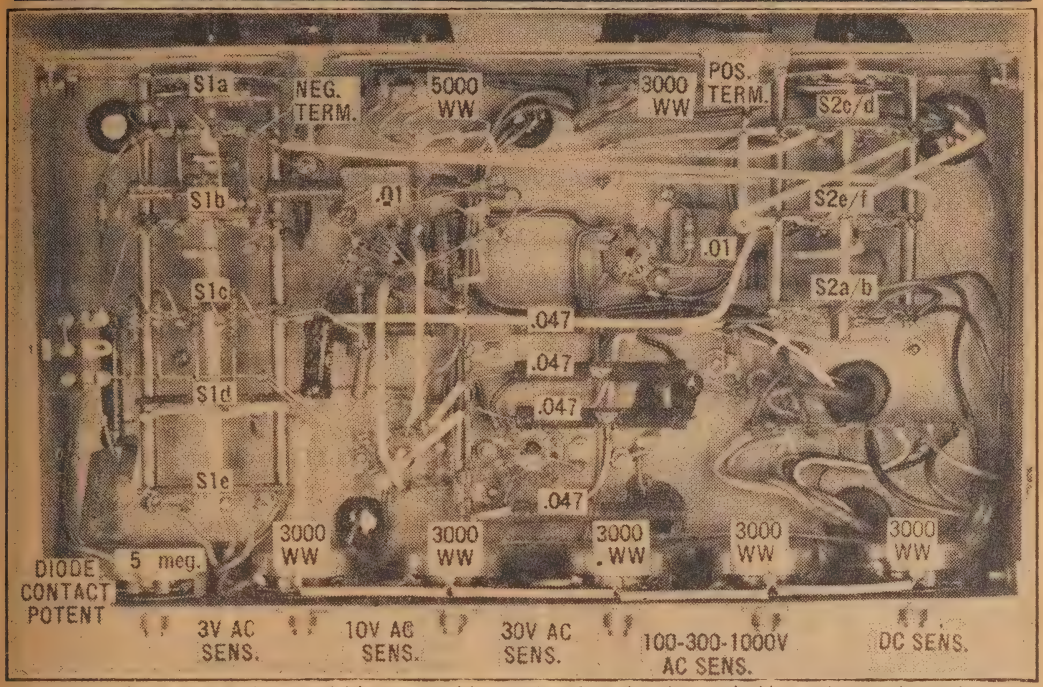

The style of wiring used in the original laboratory model is evident from this photograph. Most resistors and capacitors are supported by their own leads, a feature which will assist in planning the wiring details in your own case.

power dissipated in them and these need to be of the 2-watt type. They should also be mounted so that they have free air around them.

All leads in the instrument should be kept as short and as direct as possible. In the case of the leads associated with the input to the diode, these should be kept well clear of the chassis to limit the amount of input capacitance.

Those leads associated with the input voltage divider should also be kept clear of the chassis to avoid leakage currents. In our instrument these leads were covered with a high quality sleeving, but even this is inclined to develop leakage with the passing of time and it is as well to have it clear of any other circuits or earthed points.

INSULATION

As the instrument is capable of measuring leakage resistances in excess of 1000 megohms, the terminals used for the input circuits must be of good quality, if they themselves are not to have a leakage of this order.

For this reason we mounted the positive terminal of the instrument on two 1in discs of 1-8in Perspex. These are placed either side of the instrument panel and held in position by the centre terminal screw and a semi-circular cutout in the front edge of the chassis.

The hole in the front panel is 3in diameter and can be cut with the normal 9-pin Noval socket punch.

The .01 mfd capacitors used in the circuit are of the mica type, as these can be relied upon not to develop excessive leakage currents. The only other capacitor in the circuit, with the exception of the power supply electrolytics, is the .05 mfd unit for the input to the diode circuit.

SMALL SIZE

While a mica type would be preferable, the value required is rather large, so that a normal paper tubular is used. In the interests of keeping the input capacitance of the instrument on AC to a low value, this capacitor should be spaced off the chassis. It is not necessary to use mounting pillars for this as it is possible to support it between the switch contact and the diode valve pin.

The 3-volt battery which is used for the ohms ranges is mounted on the top of the chassis and held there by a small bracket. The amount of current drawn from this battery is negligible and its operating life should be of the same order as its shelf life.

The scale of the finally calibrated instrument is illustrated and a few points about this, and the circuit arrangements that have been used to obtain this scale would be appropriate.

One of the most useful scales on an instrument of this type is the db. scale, which makes the work of taking amplifier and other response curves very much simpler.

Now without going into the mathematics of the business an increase in a voltage, by a factor of 10 times, is an increase of 20 db.

This means that if the voltage ranges of our instrument are 10, 100, and 1000 volt then there is a difference of 20 db. between them.

Thus, if we have a basic db. scale for the 10-volt range, when the meter is switched to the 100-volt range it is only necessary to add a fixed amount of 20 dbs. to the meter reading to get the correct db. level for the new voltage being measured.

However, if we are to read all possible circuit voltages with a good degree of accuracy we must have ranges whose full scale deflection has values which are intermediate with the 10, 100, and the 1000 volt ranges.

DB SCALE

Furthermore, to avoid the need for two db. scales, it is desirable to have ranges which will allow the addition of a round number of decibels to be added to the basic db. scale in the same way as we can with the ranges already discussed.

If we take a range of 25 volts this requires a value of 7.559 dbs. to be added to the original scale. Similarly a range of 50 volts will require a value of 13.979 to be added. Even though this latter value could be rounded off to 14 dbs. it is hardly a convenient value to use.

The other approach is to decide on a convenient value of dbs. and see what the voltage ranges would be for this.

As we already have values of 20 dbs. between the 10, 100 and 1000

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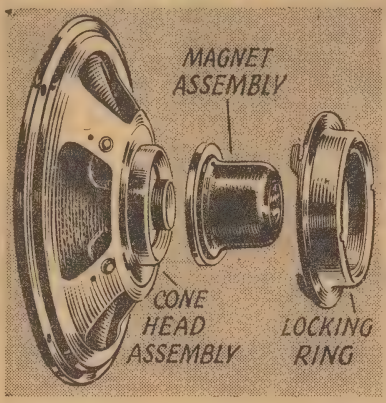

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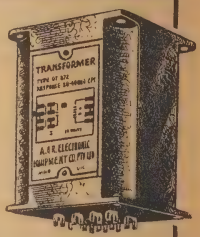

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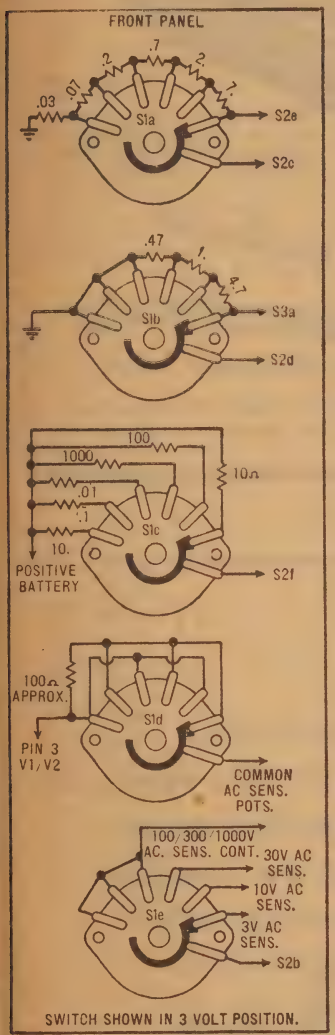
volt steps, the most logical figure to adopt would be 10 db. steps in between these and the other ranges.

Now 10 db. increase on 10 volts gives a FULL SCALE VOLTAGE range of 31.62.

At first this does not seem to be a great help. However, provided that the sensitivity of the instrument is set so that the needle of the meter will reach the normal full scale point for a voltage of 31.62, we are at liberty to mark the scale, and the range, to a convenient point lower down on the scale.



The resistors associated with the three upper switch banks are best soldered to the switch before it is installed in the chassis.

This then is the reason for the shorter length of the 3, 30 and 300-volt scales.

The arrangement greatly simplifies the reading of the db scale and the range switch can be marked to have 10 db steps between ranges.

As mentioned earlier, the main voltage range selection for the instrument is accomplished by the input voltage divider. If we are to use odd values for the full scale deflection figures, then the resistors will also need to be odd values. It is to overcome this difficulty that the switch section S1/d is used.

The voltage divider network is designed just as if the full scale ranges were to be 3, 10, 30, 100, 300 and 1000 volts. On the "3" series, an additional resistor is switched in series with the meter movement to decrease its sensitivity and give a normal full scale of deflection of 3.162 volts.

This circuit is made inoperative by the switching when the instrument is in the ohms position, where the sensitivity must remain constant on all ranges.

REFERENCE LEVEL

Before leaving the db scales, it is worth mentioning the reason for placing the 0 db point at a value of 5 volts.

When the instrument is in use for taking response curves it is most convenient and accurate to be operating the meter near the centre of its scale. Also, as the voltage readings will be taken across high resistance circuits there is no valid reason for using reference levels such as 50 mW across 600 ohms or any of the other standards which have been used and suggested at various times.

The additional scale for the 3-volt AC measurements is necessary because of the non-linearity of the diode rectifier. Even so the calibrations are very close to the 30 volt scale and very little error will occur if the db scale is used when the meter is set on the 3 volt AC range.

The lowest marking on the scale is for the centre zero position of the meter. This centre zero is obtained on the DC positive position of the function switch by using the zero set control to move the meter needle to the centre of the scale. This facility is particularly useful in the alignment of discriminator circuits when the output voltage will vary from negative to positive depending upon the frequency of the input to the circuit.

WIDE RANGE

The other scale on the dial is the ohms range, which is of the forward reading type, having the maximum resistance values at the full scale end of the dial. It is possible with this scale and the ranges provided to measure values of resistance between 0.2 ohms and 1000 megohms.

Because of the provision of a number of preset potentiometers, the setting up of the instrument and its calibration does not present any particular problems.

Firstly the function switch is set to the DC positive position and the range switch to the 3-volt DC position and the instrument allowed to warm up for 10 minutes. It should then be possible to set the needle of the meter to either the zero position on the scale or to the centre zero position.

If the needle cannot be set to the centre position it may be necessary to wire a resistor in series with one or other of the relevant plates. This will have the effect of off-setting the zero to the one

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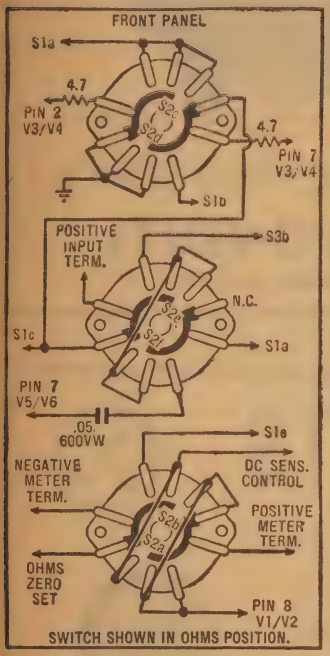
direction. Of course, increased deflection could be obtained by increasing the value of the zero set control but, if this is done, it does make the setting of the control more critical.

With the meter set to the meter scale zero, there should be no change in the position of the needle when the function switch is changed to DC negative. A point to watch here is that the mechanical zero of the instrument is correctly set before the instrument is switched on, or misleading results will be obtained.

The meter is then switched to the AC position and, without altering the zero set control, the meter pointer is brought back to zero by adjusting the control on the back of the chassis which is marked "contact potential adjust". The range switch is then set to the 10 volt position and the needle checked for zero.

If there is any change in its position it may be necessary to alter the



Use this diagram in conjunction with the schematic circuit to wire the AC-DC-Ohms switch.

value of the 1 megohm resistor mounted on the switch wafer S1/b. The range switch can then be set to the 30 volt position, the zero setting again checked and if necessary the value of the .47 megohm resistor modified. The values that we used for these resistors were found to be quite satisfactory and very little change from these should be necessary.

The meter can then be reset to the DC positive position and the range switch to the 10 volt range. This is the basic range whtch will need to be calibrated first. It is assumed that the resistors in the voltage divider network are correct, as the calibration procedure does not allow for any errors in these resistors.

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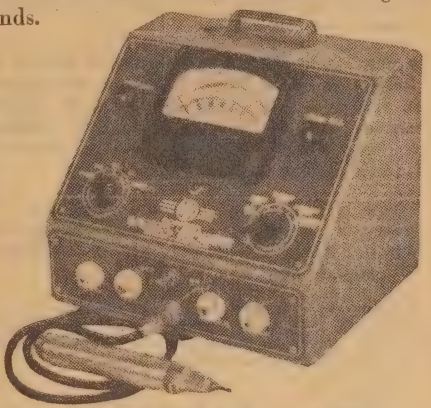

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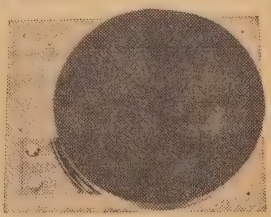

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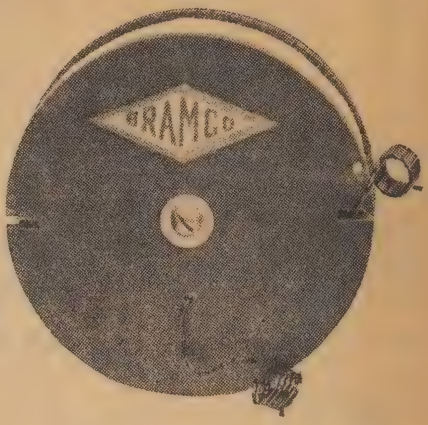

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is fed into the instrument and the DC sensitivity control adjusted to give full-scale deflection on the meter. The input voltage is then reduced to three volts and the range switch on the meter set to the 3-volt position. The meter should then read full scale on the 3 volt range. Note, of course, that this is less deflection than the 10 volt range because of the shorter scale.

If the meter does not read correctly it will be necessary to modify the value of the 100 ohm resistor associated with the switch section S1/d.

This completes the calibration of the DC ranges as the rest of the ranges will be controlled automatically by the main voltage divider.

As the same basic range of three volts is used on these other ranges, if this is set correctly as outlined above and the voltage divider is correct, it follows that these other ranges must also be correct.

CHECK ON ACCURACY

Of course, a check should be made if only to verify the accuracy of the voltage divider.

The AC calibration of the instrument can now be carried out and the ranges can be taken in their normal order.

The meter is set to the 3-volt position and the zero checked for adjustment. A voltage of three volts RMS is fed into the instrument and the control on the rear of the chassis, marked " 3 volts AC sensitivity", adjusted to give the desired full scale deflection.

This procedure is adopted for the other AC ranges, the appropriate control being adjusted for the range being calibrated.

Once these controls have been set they should be sealed to prevent further movement. For this purpose either sealing wax or any suitable varnish could be used.

The only range left to check is the ohms range. The function switch is set to the ohms position and the range switch to the lowest ohms range. When the leads of the instrument are shorted the meter needle should return to the same zero position as on the other instrument functions. When the leads are open-circuited the needle will swing up-scale.

ZERO SETTINGS

This deflection is adjusted to full scale by means of the ohms zero set. These zero settings are quite separate adjustments but it must be remembered that the meter zero must be adjusted first.

A check can now be made that all ranges are operating satisfactorily by connecting known resistors across the measuring terminals. When the instrument is set to the megohms range it is possible to check for any terminal to earth leakage as this will show as a measured resistance on this range.

The instrument is now ready to be used in the workshop or laboratory and will prove its use in many applications. At a later date we will be describing an RF probe to be used with it which will further increase its usefulness and make possible the accurate measurement of voltages up to the very high frequencies.

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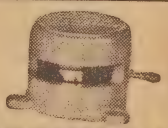

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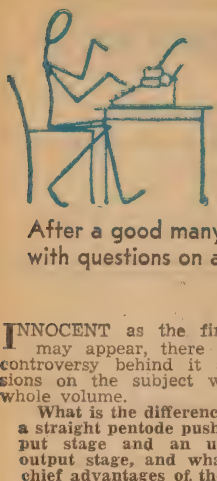


Here's your answer, Tom!

After a good many questions on radio frequency matters, Tom's mind now seems to be occupied with questions on audio, and amplifiers. Add to this some crystal problems and you already know what we are going to talk about this month.

INNOCENT as the first question may appear, there is a lot of controversy behind it and discussions on the subject would fill a whole volume.

What is the difference between a straight pentode push-pull output stage and an ultra-linear output stage, and what are the chief advantages of the latter?

As far as the two circuits are concerned, Tom, there is very little difference to be seen, since only the screen connections are altered for ultra-linear. These are taken to tappings on the primary of the output transformer, instead of to B-plus.

However, there is a noticeable difference in the performance and characteristics of the two circuits, and the ultra-linear connection has the advantage for high fidelity applications.

Take the matter of power output: The pentode has a very high plate efficiency; that is to say, for a given amount of power supplied to the valve, the useful power output is high. The ultra-linear circuit retains this efficiency, although with some valve types there is a slight drop in output power.

In other characteristics, however, the ultra-linear stage is much more similar to a triode output stage. Its plate impedance is very much lower than that of pentodes. For this reason it is more suitable for use with loudspeakers, which require a low impedance driving source and rely on it to give adequate damping.

LOW PLATE IMPEDANCE

This low plate impedance also accounts for the reduced distortion percentage, which is a characteristic of ultra-linear circuits. Just why this is so, though, goes far beyond the scope of this article.

The inherently low distortion of the ultra-linear stage also comes in handy when feedback has to be applied to the amplifier. Extremely low distortion figures can be achieved with much less feedback than would be necessary to correct the performance of a pentode amplifier.

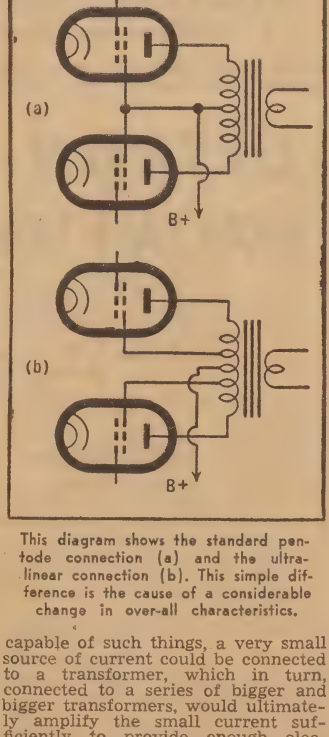
In any case, there is a limit to the amount of feedback one can apply to an amplifier because of instability problems. By and large, an ultra-linear amplifier with a certain maximum feedback applied will be a better amplifier than a comparable pentode affair with the same amount of feedback.

In summing up we can say, that the ultra-linear output stage is economical as far as power supply requirements are concerned, gives better loudspeaker damping than an equivalent pentode amplifier and has less inherent distortion. Because of this, the designer does not have to rely so heavily on negative feedback and there is less risk of running into trouble with instability or "ringing" effects on transients.

Does the transformer on the loudspeaker amplify or is it only there for coupling?

Some years ago we published a little sketch on these pages, illustrating what would happen if transformers were capable of amplification.

The main idea behind the sketch was that, if transformers were



This diagram shows the standard pentode connection (a) and the ultra-linear connection (b). This simple difference is the cause of a considerable change in over-all characteristics.

capable of such things, a very small source of current could be connected to a transformer, which in turn, connected to a series of bigger and bigger transformers, would ultimately amplify the small current sufficiently to provide enough electricity for the whole of Sydney.

Unfortunately, Tom, such is not the case. A transformer just cannot amplify. In fact, it is not even 10 pc efficient, which means that you do not even get out of it all that you put into it.

The transformer must then be just there, as you suggest, to couple the output valve to the loudspeaker. But the question immediately crops up. Why could the speaker not be connected directly into the plate circuit of the valve?

The reason is simply that the plate impedance of an output valve is fairly high in relation to the impedance of a moving-coil speaker. This means, in practice, that fairly high voltages will appear on the plate, at a relatively low current. On the other hand, the loudspeaker requires a low driving voltage at a fairly high current.

TRANSFORMER ACTION

And that is just what the transformer does: it transforms a high voltage at low current into low voltage at high current.

There is also another point we have to keep in mind . The voltage on the plate of the output valve consists of two components: (1) the alternating signal current and (2) direct current required for operation of the valve. As the loudspeaker only requires AC for its operation it is desirable to keep the DC voltage out of it.

This automatically happens, if a transformer is connected into the plate circuit of the valve, because the DC component flowing in the transformer primary will not induce a current in the secondary. Thus the two components are effectively separated.

The following question deals with yet another part of audio amplifiers.

What does a phase splitter do in an amplifier?

Before we go any further on this subject, Tom, let us get one thing clear: Phase splitters or, more correctly, phase inverters, can only be found in amplifiers employing push-pull output stages. That is the only time they are required.

They are actually an essential part of any push-pull system.

As you know, Tom, every AC signal consists of a positive and a negative half cycle. In a single-ended amplifier both these halves are amplified by the one valve. However, due to the slight non-linearity of the valve characteristic the two halves of the cycle are amplified slightly differently, or, as more commonly known, they are distorted.

If we now take two output valves

and feed the signal to them in such a manner that in each valve the distortion occurs in the opposite direction to the other, the combined output from the two valves will cancel the distortion to a great extent.

To do this, some arrangement is needed to convert the original one signal into two identical signals of opposite polarity. In electrical language the two signals then are said to be 180 degrees out of phase. This also explains why the phase "splitter" is often referred to as a phase "inverter".

There are several types of phase splitters, or phase inverters, and good examples of them can be seen in the circuits of the various Playmaster amplifiers. One of the best-know types is the cathode-plate phase splitter and we will use this as an example. We might add, that this type is an Australian invention and it was first published in the predecessor of Radio, TV and Hobbies, namely The Wireless Weekly.

BASIC CIRCUIT

The basic circuit consists of a triode, or a triode-connected pentode. One resistor is inserted between the cathode resistor and earth, and another, of equal value, between plate and B-plus. To retain correct operating conditions for the valve, the grid resistor is returned to the junction of the two resistors in the cathode circuit.

The input signal is fed to the grid in the normal manner but the output is taken from both the plate and the junction of the two resistors in the cathode circuit. From here the signal goes to the grids of the output valves.

What actually happens is this: The grid, with no signal input, is negatively biased in the normal manner. The voltage drop across both the plate and cathode resistors is the same.

When, however, a signal appears on the grid, say positive going, the current through the valve will increase. With the increased current the voltage across the resistor in the cathode circuit will tend to rise. Conversely, with a negative going signal on the grid, the current will be smaller, and hence the cathode voltage will drop.

Just the opposite will happen at the plate of the valve. With a positive-going-signal the plate voltage will be reduced, and with a negative-going signal, it will increase.

Thus, we now have two signals, identical in every way, but of opposite polarity, or 180 degrees out of phase. These signals are then fed to the two output valves, and their signal currents combined in the output transformer to give an output of very low distortion.

There are several other ways in which phase inversion can be achieved, but to discuss them all would be too involved in this article.

And now to our crystal problem.

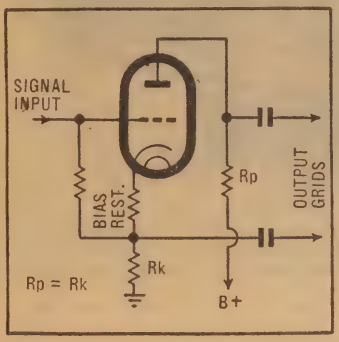
What is the resistance of a crystal detector?

That is something, Tom, that one cannot answer forthwith by quoting a certain number of ohms, because, for one thing, that depends on the crystal detector you have on your hands, and, for another, it depends on which way you look at the crystal.

This latter part of the statement may cause some raising of eyebrows, but it is nevertheless a fact.

You see, Tom, crystal diodes are essentially rectifiers, and, ideally, they should prevent the flow of current in the one direction altogether, but should offer no resistance whatever in the other direction.

Unfortunately, practical crystal diodes are very far from this ideal, and they have a measureable resistance in both directions. Rectification



Basic circuit of the "plate-cathode". phase-changer

only occurs because, for the same applied voltage, the current in one direction exceeds the current in the other direction.

A typical figure of "forward" resistance, i.e., the direction of greater current flow—would be 200 ohms. The "reverse" resistance of such a crystal diode would probably be of the order of 200,000 ohms.

You may have noticed, too, that so far we have been speaking of forward and reverse resistance only, but have made no mention of whether this applied if you look at the crystal from the cat's whisker end.

The point is that it depends on the materials used in the construction of the diode, whether the current flows from cat's whisker to the crystal, or vice-versa. The same applies to crystal diodes of the junction type. In all cases the resistance through which the greater current flows, is referred to as the "forward" resistance.

Are "printed circuits" the circuits you publish in your magazine?

Yes, and no, Tom. The circuits we publish are certainly printed, but that is not what the expression usually means. Printed circuits are used on automatic assembly lines. The circuit itself is first printed on a copper-plastic sandwich, and then all the copper not required is etched away. This leaves part, or all, the "wiring" for a receiver or some other apparatus on the plastic backing.

Holes are then punched in the sandwich in the correct places and pigtails and lugs of components inserted into the holes by machines. The copper side of the sandwich is then dipped in a bath of flux and solder and all soldered connections made at the one time.

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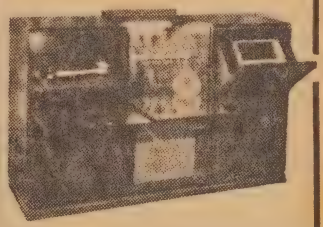

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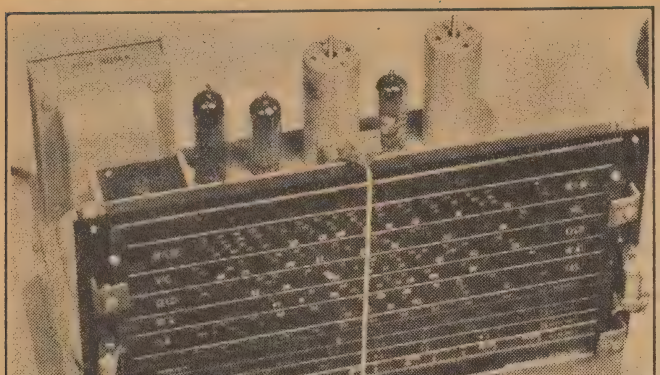


Front view of the receiver showing the controls and the large, easy-to-read dial.

A NEW MULTI-BAND RECEIVER

This receiver is built around a new coil kit just released which has not only the standard broadcast and short-wave tuning ranges, but in addition bandspreads three of the international short wave bands for easier identification and tuning. This means that in all there are five tuning ranges available at the turn of the wave-change switch.

by L. Varady

THE extent of the broadcast band coverage is obvious, of course. The shortwave band as such covers 16-50 metres. The three bandspread ranges are the 19, 25 and 31 metres band.

This is pretty "de-luxe" kind of tuning, and it means that no matter what your interest in the ether, it is catered for in a particularly effective manner by this tuning unit.

Naturally, the job in lining up such a device is quite a proposition, but the manufacturers have removed this necessity on the part of the constructor.

PREALIGNED

Being completely wired, the unit incorporates all the components necessary for the RF and converter stages, including the wave-change switch, valve sockets and the tuning gang. Thus it is really the complete front end of the receiver.

The type of assembly allows the manufacturer to align the units in the factory. To the home constructor, who rarely has access to the necessary test instruments, this means optimum performance with a minimum of trouble.

To complete the receiver, one needs to provide at least one stage of IF amplification, a suitable audio amplifier and a power supply, all assembled on a suitable chassis.

This is in fact what we have done in working out the details of this new set.

The circuit is straightforward and needs little comment. A 6BA6 is used as an RF valve, while the converter is a 6AE8. All the wiring for these two stages is included in the tuning unit and therefore not shown in the circuit. All you have to worry about are a few external connections.

The output from the converter is fed to a conventional IF stage, employing a 6N8. The diodes in this valve are used to supply the AVC voltage. More will be said about the AVC system a little further on.

A 6BD7 serves as the second detector and audio amplifier feeding a 6BQ5 (EL84) in the output stage. Plate-to-plate feedback is employed between the output stage and the audio stage.

An 80 mA power transformer and a 5Y3 rectifier supply the HT to the set in a standard circuit arrangement.

One of the unusual points in the receiver is the AVC line. In the standard arrangement, standing bias on the RF, converter and IF valves is obtained by returning the AVC line to a back bias resistor.

However, the valves in the tuning unit are cathode biased, and this approach is therefore impracticable.

The problem was overcome by using cathode bias for the IF valve and returning the AVC line directly to earth. In this fashion the standing bias on the first three valves provides the required delay voltage for the AVC.

You will also notice that the tuning unit does not provide for the connection of a pickup, and it is necessary to use terminals connected by a link, if a pickup is to be used.

Now for some constructional details.

The coil unit used has dimensions identical to that used in the Three Band Six receiver published some 12 months ago. Thus there was no need to design a new chassis and we used the same one as specified for the earlier receiver.

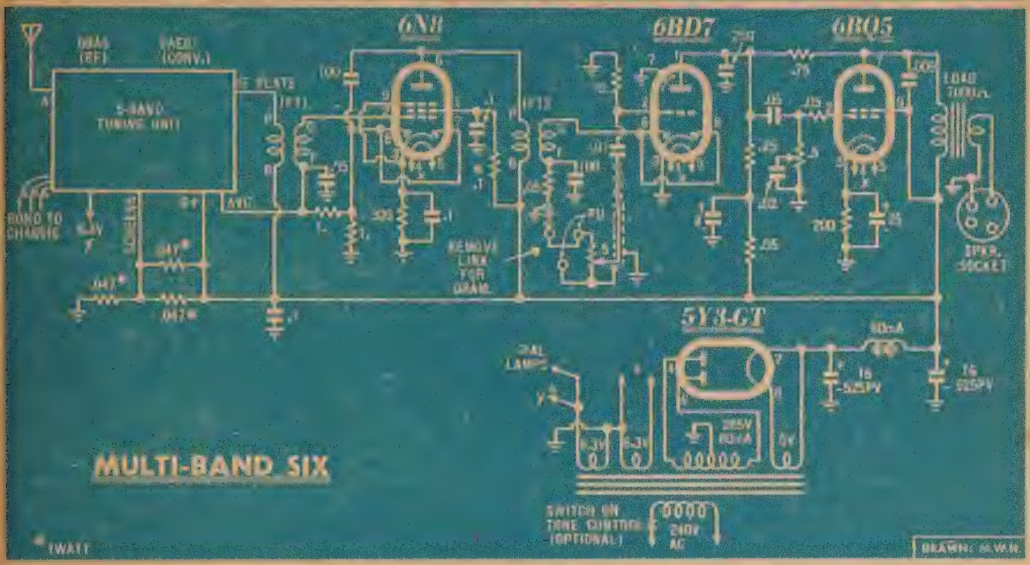
The chassis measures 9½ x 12 x 3in and is provided with a cut-out to accommodate the tuning unit and the dial mechanism. Looking at the chassis from the rear, this cut-out is along the front edge toward the left hand side.

Before attempting any of the wiring, it should be ascertained that the tuning unit and dial fit correctly. For this purpose, the switch shaft of the unit is passed through the appropriate hole in the front and, holding it at an angle, the tuning gang is passed through the cutout.

MOUNTING THE UNIT

After the mounting holes for the unit have been marked and drilled, the same procedure is repeated making sure that the unit sits squarely in respect to the chassis. It will be noticed that, with this arrangement, there is insufficien

CIRCUIT DIAGRAM OF MULTI BAND SIX RECEIVER



Only the supply leads to the tuning unit are shown in the circuit, as all the components for this part of the circuit are already included in the unit. Alternative connection for the pickup is shown overleaf.

room between the unit and the front of the chassis to accommodate the flywheel on the dial.

Taking care not to break the dial glass, the flywheel is slipped off and replaced by a ¼in washer, after which the shaft is drilled through, and a piece of wire, or still better a small split pin, pushed through the hole to retain the shaft in its original position.

The excess shaft can then be cut off, and the dial put into position.

If everything fits neatly, both the dial and the tuning unit can be removed and the wiring commenced.

NO FLYWHEEL

The removal of the flywheel will not affect the set or the tuning in any way, except that the dial pointer cannot be spun quickly from one end of the scale to the other. In practice this is a minor point.

The connections to the unit are made at the rear, and in order to have short leads for RF signals, the first IF transformer occupies a position near the rear left hand corner of the chassis.

The IF valve, second IF transformer, audio and output valves follow in their sequence along the rear edge of the chassis.

Power transformer, rectifier valve and choke are accommodated on the right hand side of the chassis, with the latter nearest the rear.

A set of this size will undoubtedly be used with one of the larger size speakers, and it should therefore have an output transformer of suitable dimensions. As it is, the layout does not permit the output transformer to be mounted above the chassis, and one of two mounting methods could be adopted.

Some loudspeakers have a bracket attached for the express purpose of supporting the output transformer. The disadvantage of this method is that the plate leads have to be extended, and it would be possible to remove the loudspeaker plug while the set is in operation.

This would open the plate circuit of the valve and may have disastrous results, at least as far as the output valve is concerned, for it would be operating with screen voltage but no plate voltage applied.

For this reason we have adopted the alternative solution of mounting the transformer underneath the chassis in the position shown in the photo. Even if the speaker plug is removed the value of voltages will not now be disturbed.

This just about covers the placement of all major components. The remainder of the circuit is fairly easy to wire, because the stages follow each other in a straight line. Thus it is possible to use point to point wiring, at least in the IF stage. To do this, however, sockets and

PARTS LIST

- 1 Chassis, 9½ x 12 x 3in.
- 1 5-band tuning unit (QWR5)
- 1 Dial to suit (USL 46, AWA gang).
- 2 455 Kc IF transformers (Nos. 1 & 2)
- 1 Power transformer 285 volt per side, 80 mA, 6.3V, 6.3V, 5.0V.
- 1 Filter choke, 80 mA.
- 1 Speaker with output transformer to suit (see text).
- 1 Octal valve socket.
- 3 9-pin miniature valve sockets.
- 1 Miniature 4-pin speaker socket.

CAPACITORS

- 1 25 mfd 40 PV electrolytic.
- 2 16 mfd 525 PV electrolytics.
- 1 8 mfd 350 PV electrolytic (miniature type preferred).
- 2 0.1 mfd tubular 350V.
- 1 0.1 mfd tubular 200V.
- 1 .05 mfd tubular 350V.
- 1 .05 mfd tubular 200V.
- 1 .02 mfd tubular 350V.
- 1 .01 mfd tubular 200V.
- 1 .005 mfd mica.
- 1 250 pF mica.
- 2 100 pF mica.

RESISTORS

- 1 10 meg, ½W.
- 2 1 meg, ½W.
- 1 .75 meg, ½W.
- 1 .25 meg, ½W.
- 1 0.1 meg, 1W.
- 3 .05 meg, 1W.
- 3 .05 meg, ½W.
- 1 300 ohm, ½W.
- 1 200 ohm, 1W.
- 2 0.5 meg potentiometers.

VALVES

1 6BA6, 1 6AE8, 1 6N8, 1 6BD7, 1 6BQ5, 1 5Y3-GT.

SUNDRIES

4 terminals, 4 knobs, hook-up wire, power flex and plug, 4ft (approx.) shielded wire, 1 8-tag strip, 1 5-tag strip, 1 2-tag strip, small quantity of bare tinned copper wire, nuts, bolts, washers, solder lugs, 1 large grommet, 2 3/8in grommets, small quantity of spaghetti tubing, 2 dial lamps, 1 DPDT Oak SW (if required).

NO TEST EQUIPMENT IS REQUIRED FOR THE Q PLUS "PRE-FAB" TUNING UNITS

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3. S/W bandspread 19 M (14.8—15.6 Mc/s)
4. S/W bandspread 25 M (11.5—12.1 Mc/s)
5. S/W bandspread 31 M (9.35—9.9 Mc/s)

VALVE TYPES
6 BA6 R.F. Amplifier
6 AE8 converter

DIAL
Type "EFCO" USL46 bandspread

MOUNTING
Unit designed to fit on right hand side of chassis with I.F. amplifier and audio sections along back. A cut out 5in x 6in with 4 holes anties 4½in and 6¾in apart, bolts will then pass through mounting grommets on unit.

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B/C —— approx. 2 uV average
S/W —— approx 4 uV average
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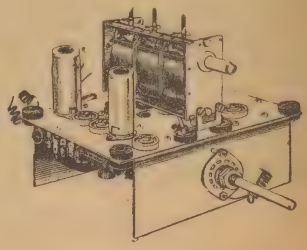

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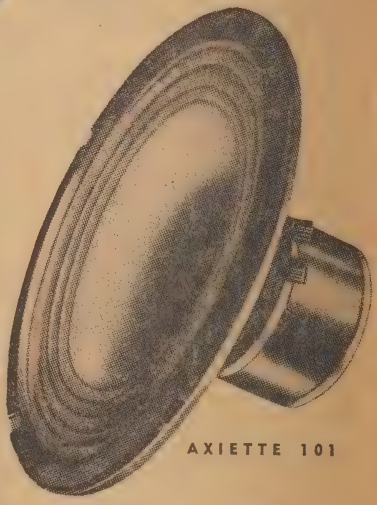

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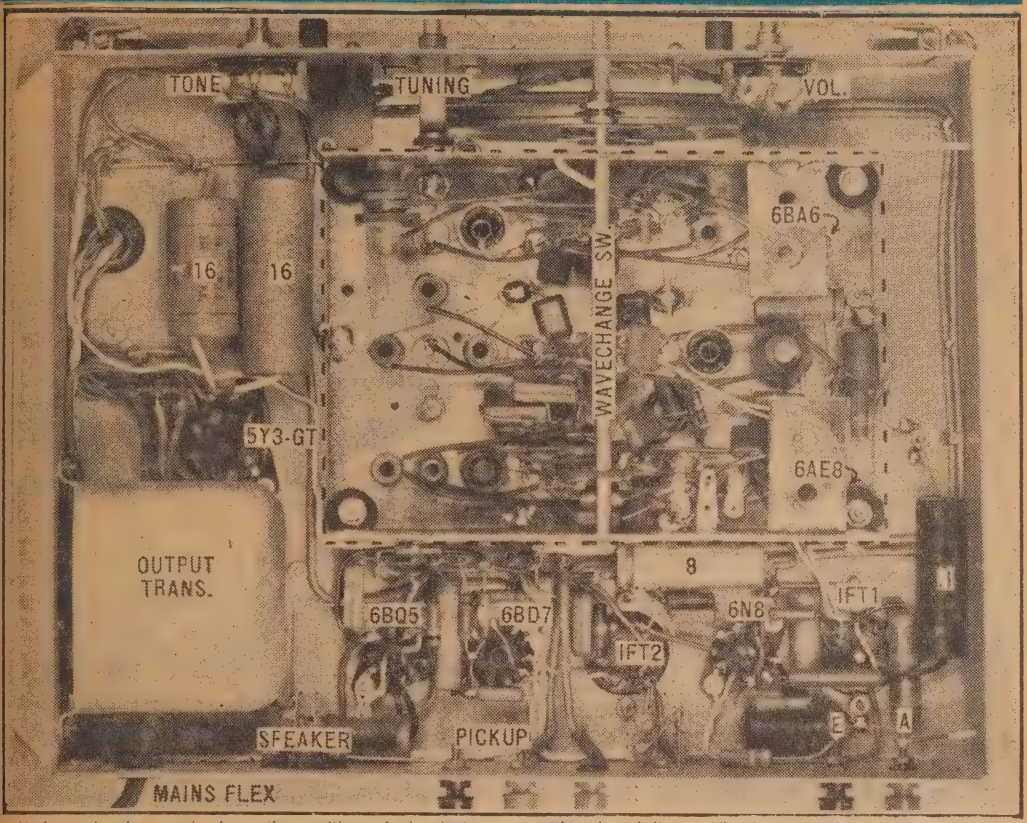


Underneath photograph shows the position of the tuning unit within dotted line. All trimmers and cores are sealed, as they are prealigned.

coils must be orientated as in the original.

The first IF transformer is mounted with its grid and AVC pins toward the IF amplifier socket, which in turn is mounted with the gap between pins 1 and 9 toward the IF transformer. The second IF transformer is mounted with its plate and B plus pins toward this socket.

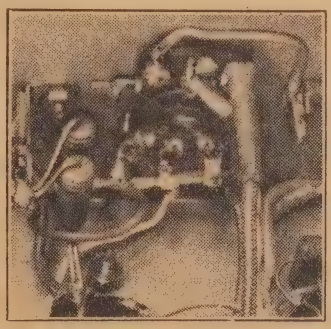
A tagstrip, mounted on the rear wall of the chassis, carries a voltage divider comprising three .047 meg 1W resistors, which supplies the screen and oscillator anode voltages for the tuning unit.

AUDIO SECTION

Components in the audio section of the receiver are supported between the respective valve pins and an 8-terminal tagstrip mounted directly alongside the tuning unit. The only exception in this respect is the cathode resistor and bypass capacitor for the output valve. These find a place along the rear wall of the chassis, and attach to a lug under any convenient mounting bolt.

As obvious from the circuit, the diodes in the 6BD7 serve as the second detector. From here the audio signal is taken by means of shielded cable to a terminal on the rear of the chassis. From an adjacent terminal a shielded lead conveys the signal to the volume control on the front of the chassis, and from there back again to the grid of the audio amplifier. The two terminals are bridged.

A further terminal at the rear of the chassis is an earth connection for the pickup. This arrangement, although not as convenient as switching, is necessary because there is no provision on the coil switch itself for a pickup position as is sometimes the case.



Phootgraph shows the wiring of the alternative pickup connection in position.

It is not very difficult to fit a switch at the rear of the chassis near the pickup terminals which will switch the first audio grid either to the pickup or to the tuner. One section of this switch removes the screen voltage from the tuning unit in the pickup position to avoid the danger of radio "play through" due to the capacity between switching points.

SEPARATE DIAGRAM

A separate diagram shows how this can be done. The position of the switch at the rear of the chassis is no great inconvenience. At a pinch, the switch might be fitted with extended leads and mounted on the gramophone motor board.

A further shielded cable connects the tone control, again on the front of the chassis, into the circuit.

There is plenty of room to the right of the tuning unit under the chassis to accommodate any size of electrolytic capacitors you may have

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A Basic 5-Valve Receiver (p. 64)

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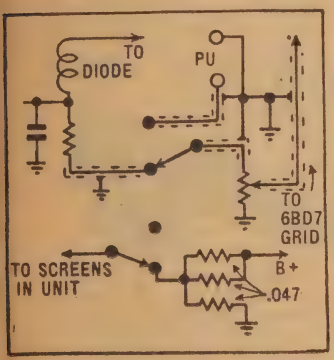
on hand. The terminal strip for the mains connections also finds its place here.

The heater leads may also be terminated on a tag strip, although it is possible to do as we have done to extend them by soldering the required length of wire to them and slipping a piece of spaghetti over the joints. The leads are then taken directly to the nearest valve socket filament terminals.

ONE SIDE EARTHED

In wiring up the filaments, remember that, in the tuning unit, one filament terminal of each socket is earthed to the body of the unit, which in turn is earthed to the chassis. As one side of the filament winding will be earthed to the chassis in any case, it is only necessary to run a single "hot" filament lead to the unit. The return path back to the transformer will be made via the metal portions of the unit and the chassis.

With the wiring completed, the tuning unit can be replaced and mounted, and the leads connected to the respective points in the circuit, according to the code supplied with it. The aerial lead will most likely be too short, as it is taken from the front of the unit right around the side of the chassis, to prevent any pickup of stray RF. It would therefore be advisable to unsolder it, replace it with a lead



Alternative circuit for connecting pickup.

of suitable length, and to connect it to the aerial terminal at the rear.

At this stage, the receiver could be put into operation, without the rectifier at first, to see if the filament wiring is correct. If everything is normal, the rectifier could also be plugged in, watching it for signs of arcing or overload.

CONNECT LOUDSPEAKER

It must be remembered that these tests should be carried out with the loudspeaker connected.

Although the IF channel may not be accurately aligned at this stage, there should be some sign of activity, at least on the broadcast band.

The last item, the dial, is now fixed into position. It should be screwed on loosely first. The screw holding the drum in place is removed and the drum slipped over the shaft of the tuning gang. It may be necessary to loosen the dial cord to do this.

As the tuning unit is prealigned in the factory, the alignment presents no problem, and unless accurate equipment is available, the adjustments on the unit itself should not be touched. All that has to be done is to line up the tuning gang with the station markings on the broadcast band.

Even the IF transformers should not require much adjustment, because they are usually brought very near the mark in the factory. However, for optimum results, they should be touched up for maximum sensitivity.

SIMPLE PROCEDURE

This can be done quite accurately with a multimeter, even though there is no signal generator handy, by measuring the plate current of the IF amplifier valve. This is controlled by the AVC, and shows a pronounced dip on a strong signal. The procedure is quite simple.

The B-plus connection is removed from the appropriate pin of the second IF transformer and a multimeter connected between the pin and B-plus. The multimeter should be set to the 10 mA range. The set is then switched on and tuned to a station on the dial. As the station is tuned in, the meter reading will drop from about 5 mA to perhaps 3 mA on a strong signal.

The signal strength of the station selected should not be too high—just sufficient to give an easily recognisable drop in the meter reading. It may not be necessary to have an aerial connected to the receiver.

With the signal tuned in, the cores of the first IF transformer are adjusted for the minimum reading on the meter. If the IF transformers are new, no more than a turn or so on each core should be necessary.

PEAK, NOT DIP

The second IF transformer is now peaked, following the same procedure, except that one of the cores when adjusted will cause a rise in plate current instead of a fall.

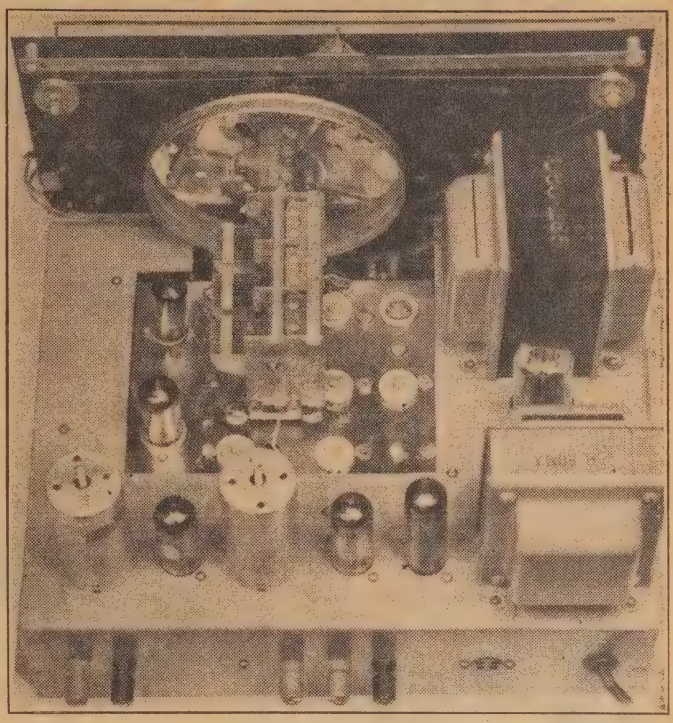
You will have no trouble in identifying this core, as you will easily detect the drop in sensitivity, which will occur if you try to peak it for a lowest current reading.

Actually the core concerned is that which tunes the winding connected to the diode, but it is almost impossible to identify it by inspection without opening the transformer.

As the intermediate frequency is the same on all bands, it will be sufficient to align the transformers while receiving on the broadcast band where you are most likely to find steady signals.

Once the IF channel is aligned, the set can be put into its cabinet, and it is ready to take up normal operation.

LAYOUT OF MAJOR COMPONENTS



Placing of major components is clearly shown in the rear view of the receiver.

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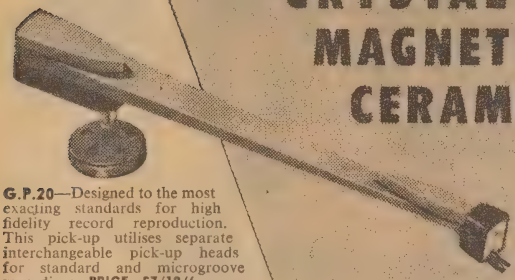

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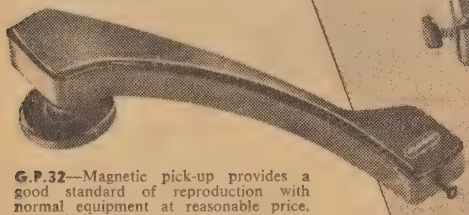

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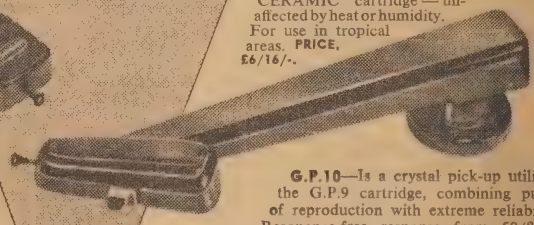

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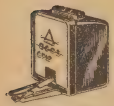

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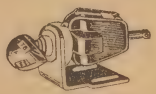

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FROM THE SERVICEMAN WHO TELLS

Four valve mantel sets which are completely dead don't usually promise much in the way of "copy", yet one I encountered this month was rather unique. Somewhat out of the ordinary also is a problem concerning a portable loop aerial.

THERE were also a couple of very interesting letters in this month's mail and you will find the relevant portions reproduced on the following pages. I find them intriguing in several respects, not the least being the fact that they come from such contrasting places as Darwin and Dundee (Scotland).

Our Dundee correspondent is an ex-Australian (migration in reverse?), who is now working for a large radio and television retail organisation in Scotland. His comments on television are particularly interesting in view of the speed with which things are happening here. (Yes, it's closer than you think!)

AC/DC SETS?

As for his comments about AC/DC sets—and particularly TV versions—well, he may be right about the padded cell, but at least I have an idea I shall be in good company.

Seriously, I think most fellows are adopting a philosophical attitude about this, as they are about TV in general. When it comes, we will try to be as well prepared for it as possible and, if "transformerless" circuits become the order of the day, we shall just have to put up with them. After all, they say, you can get used to anything in time.

I must say I was rather surprised at the comment regarding the various valve types. Thank goodness we have only two systems (American and European) and virtually no interchangeability between them. In other words, there are very few "equivalents" to worry about. Maybe we should count our blessings.

The letter from Mr. C. L. C., of Darwin, is also calculated to jolt one out of one's complacency and emphasise that we city fellows could be a lot worse off. Yet jobs and conditions like this are typical of those encountered in the outback.

AUSTRALIAN TRAIT

There is another point to this story. At one time Australians were known as past masters in the art of improvisation; at making something out of virtually nothing; of never being stuck for an idea.

Of late, there have been those who would have us believe that this is a characteristic of a past generation; that the modern Australian gets everything too easily and has never developed this very desirable trait. I feel that experiences like those quoted above do more than a little to contradict this theory.

Maybe the role has changed—from the windmill mechanics and blacksmiths-cum-handy men of a couple of generations ago to the more exacting spheres of electronics and the like—and the participants have, inevitably, been pushed further out by the spread of population; but the spirit remains, and the need usually produces the man.

At least that is how it appears to me.

But enough of this philosophising and back to earth. I have the usual couple of "unusual" case histories to relate. The first concerns a fairly ordinary four-valve mantel set, which the owner pushed across the counter with the brief explanation, "I can't get anything on it, not even statics. It just went dead in the middle of the serial."

Why people imagine that the nature of the program should have any bearing on the failure of the set, or that such information could possibly be of any use to the serviceman, I can't imagine. Yet it quite definitely is so, an appreciable percentage of my customers being in the habit of proffering this information.

I can only assume that they credit the set with more good taste (in the matter of programs) than they possess themselves. If this was really so I am convinced that most sets would flatly refuse to play 90 pc of the programs!

But to return to the bench. Since the set was a supposedly straight-out "completely dead" jobs I imagined it would present no problems or be particularly interesting. Probably nothing more than a valve failure.

NOT OBVIOUS

I was rather surprised, therefore, when a preliminary check showed no obvious cause of the trouble. All the valves appeared to be OK, the HT voltage was normal, as were also all the other voltages; plates, screens, bias, &c. Further, the set seemed normally "alive" around the audio and IF section, though obviously dead from the aerial terminal.

I discarded the idea of a dead oscillator circuit, since there was none of the usual noise which is normally present under these conditions. After all, the failure of the oscillator circuit is merely an extreme case of detuning, the set being tuned to the IF, with a certain amount of not very selective tuning ahead of it in the form of the aerial tuned circuit.

No, it was something more direct than that. With the grid cap removed from the converter valve I fed in a generator signal at the IF. Everything appeared to be quite normal; sensitivity about right, adjustments only a whisker out, and so on. But as soon as I put the grid lead back in place the signal dropped to a very low level.

SOME LIFE

More careful checking this stage showed that it was not actually dead. It was possible to force a signal through it from the aerial terminal if it was a very strong one. Naturally, being a four valve set, probably operated from a poor aerial, it was compeltely dead as far as the owner was concerned.

Now I felt sure I knew the answer: a shorted trimmer on the aerial section of the gang, something which most of us have encountered at some time or other. It was easy to lift one end of the trimmer clear, but it served only to prove I was wrong, for it made no difference whatever.

Hot on the trail, and convinced that there was a short somewhere across the aerial tuned circuit, I tackled it with the ohmmeter. Naturally, I had to disconnect the actual winding from across the gang, otherwise its low DC resistance would mask any short elsewhere in the circuit.

A check on the actual winding

TRANSFORMERLESS TV RECEIVERS

Your Serviceman Who Tells would probably go stark starring mad if he handled as many AC/DC sets as I do, the average being 50 pc of radio and about 90 pc of TV. If the same technique is used in Australian TV construction I expect your serviceman will be writing his notes from a padded cell!

After using valve types in Australia, all with RMA numbers, I am slowly going crossed-eyed trying to keep up with valve equivalents. e.g., a high gain RF pentode type 6AM6 has as its equivalents the following: EF91 (Mullard), 8D3 (Brimar), Z77 (Marconi), 6F12 (Mazda), and 8P6 (I forget this one). What hope has a fellow got, I ask you?

We do quite a bit of indoor TV aerial installation in the good areas of Dundee, using a plastic "H" aerial and in some places the signal strength is quite remarkable, being able to give a negative picture on sets with AGC. Other areas need a four element "H" to even get a signal at all, it usually hiding behind tons of "snow". We are approximately 55 miles from Kirk O Shotts and it is rather mystifying, in my opnion.

Yours sincerely,
D.G.S.

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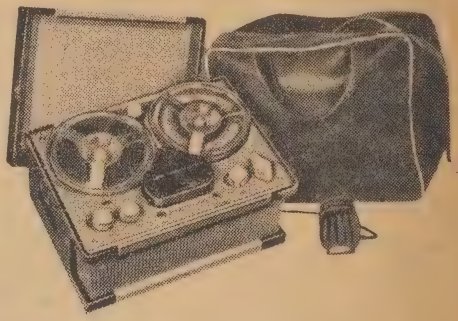

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resistance showed three or four ohms which was about normal, and enough to indicate that there was no actual short. But across the gang there seemed to be nothing abnormal, at least at first glance.

Then I noticed that there was the barest movement in the meter needle and switched it to a higher range. Immediately I did there was a reading of several thousand ohms which, although higher than I had been seeking, was still enough to wreck the performance of a small set.

But I still had to find where it was, though it was obviously in the gang since all other parts of the circuit were now disconnected. The gang wasn't easy to examine on the chassis, being pretty well surrounded by other bits and pieces. I finally decided it would be quicker to take it off the chassis and examine it in comfort.

CORROSION

Once clear of the chassis and the trouble was obvious. Between several plates of the aerial section there was a sizeable patch of corrosion. Part of it was white, part of it green, a substantial crop of whiskers bridged the two plates, and there was a faint but unpleasant smell about it.

I tried burning it out using the set's own HT supply, and this produced an impressive display of fireworks and a many times magnification of the smell, but it didn't completely cure the leakage. I tried the blade of a knife in the hope that I could scrape it clean, but only succeeded in disturbing the surface. For a while the leak vanished, then reappeared as I rotated the gang a number of times.

At this stage I was seriously considering fitting a new gang. The only snag was that it was not one of the regular brands, and I doubted whether a new one would be readily available. The set was a nondescript, unbranded variety, and finding a replacement could be a problem.

Finally I managed to get a small strip of fine emery cloth in between the plates and clean each one down to bare metal. This was rather tricky in spots, but was not really a long job. When I felt confident that all the foreign matter was clear of the plates I washed the entire gang in a bath of methylated spirit to get rid of any loose particles.

TESTED OK

Then a careful check for leakage, which was completely negative, and I wired it back into the set. As I expected the performance was now normal and I returned the set to the customer.

But what caused the corrosion in the first place? To judge by the smell I can only suggest—to put it as delicately as possible—that the gang had been subject to the attention of certain rodents; to wit—mice!

This is, of course, nothing new in the general sense, but it is the first time I have known a gang to be so badly damaged in this way. Usually it is the chassis which suffers most, though other components like coils and valve sockets are sometimes casualties.

My next story started when a customer entered the shop and asked

"NEW LAMPS FOR OLD . . ."

IN the first part of his letter Mr. C. L. C. relates some of the problems created by tropical conditions and the failure of component and set manufacturers to appreciate this. In this regard his comments are in line with those of Mr. G. F. E. and which were quoted in these columns a few months back.

The remainder of his letter appears to have been inspired by my recent story about an emergency repair on a 16mm movie projector. He goes on to say:

Another case history that was jolted out of this archive of a brain of mine (can always remember these things and never Kirchoff's Law) relates to a 16mm movie projector.

I too have struck that switch trouble. It was about this time last year, just at the onset of the 'Wet' and I had travelled over to one of the islands to service the Tranceiver. I had been over there previously a couple of times and the lads at the mission station had built up quite a legend about the marvellous feats that I had performed!!!

On my arrival this trip the boys were jubilant, as they were certain that I would be able to fix the projector so that they could have their film show. On chatting to the superintendent I learnt that they had tried several lamps in the machine but they all failed to light, although the filament in the lamp was still intact.

That night I carted tools and junk over to the recreation hall to 'have a go'. First I examined the lamps (visually) and ascertaining that they were OK (visually) I started on the projector itself.

I examined the socket for the lamp and it looked quite OK. Just to be on the safe side I swabbed the base out with Tri-Chlor-Ethyline to remove any deposits of carbon or grease. Before putting a lamp in the machine I switched it on and made quite sure that volts were actually present at that point.

All OK so far, I then put a lamp into the socket and switched on expecting to get a great blast of light issuing forth. The laugh was on me, not a glimmer out of the blooming thing. Back to the grind again, I started on the lamp this time and flashed the multimeter across the base, and there it was, we were right out of ohms!!

I then decided to rip the base off to have a look. Getting a blow-lamp from the engine house we lit it and proceeded to operate. By waving the bulb through the flame I managed to heat it to a point where I considered that it would not crack if I heated the base. These bases are made up in two sections evidently to facilitate focusing, the two being soldered together afterward.

Having satisfactorily removed the bottom portion containing the glass insulating bush, I then peered, with now bloodshot eyes, down the barrel of the lamp.

Sure enough there was the trouble, where the stranded wire had been welded to the molybdenum lead-through (or whatever else they use in these days of enlightened science) was clear evidence of burning and arcing. Evidently during the manufacturing process some fault in the welding apparatus was introducing these flaws into the lamp.

The next prolbem was to get the lamp repaired so that the show could go on. Going through my tool and spare parts box brought nothing to light that I could conceivably use to do the job.

The next port of call was the junk shop where there was a quantity of ex-wartime radar equipment that had been salvaged from a Radar station after the services had left the island.

Browsing along, searching for ideas, I came across an old Cannon type female connector. The pins of this looked as though they might do the job, so seizing it and dashing back to the rec. hall I arrived in time to prevent the "Bower Birds" (little boys to you) from making off with the remainder of my tools.

Ripping the plug apart and using a pair of very long nosed pliers, I was able to push one of the pins over the stub of the lead-through. To the other end I mechanically fixed and then sweated another piece of braid.

Fortunately the reassembly of the base was not a long or very ticklish job as I had wisely marked the two pieces of base with a scriber before dissembling it. A final check with a multi-meter and then the blowlamp treatment again and the job was done. Fifteen minutes later the show was on the go and another chapter to the C.L.C. Legend was written.

I will never forget that show, it was "San Francisco" with Jeannette MacDonald. Needless to say, the sound track was none too good but never-the-less I quite enjoyed it. They put that same show on every night for a fortnight as the supply boat was not due till that time. Ye gods, we knew that script better than the stars themselves.

Getting back to the story, on examination all the other lamps that they had tried in the machine were faulty in the same place and on the same lead-through. The last I heard was that they still have three of the lamps unused. I really feel a bit like that character in Aladdin's Lamp who went around doing the "New lamps for old" act.

Yours sincerely,
C.L.C.

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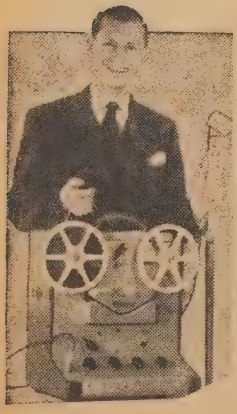

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if I could fit a loopstick to his portable. Since he didn't appear to have the set with him, and I'm always a trifle cagey about committing myself on vague questions like this, I asked him why he wanted it fitted.

He seemed a trifle surprised at this, but went on to say that he had never been very happy about its performance and someone had told him that this new aerial was just the thing to bring his set up to the mark. Therefore could I fit one?

I'm afraid I dampened his enthusiasm somewhat by pointing out that the loopstick was not a magic cure-all for every ill that befalls a portable. Before I could say whether such a modification would be worth while I would have to know (1) whether the set itself was functioning correctly. (2) The conditions under which it failed to give satisfaction, and (3) the type of aerial already employed.

OWNER'S STORY

As he did not have the set with him I was unable to determine (1) or (3). However, a little questioning brought out the story of the set's failure. The owner was in the habit of taking it on holiday trips down the coast, and it was here that the set showed up badly. According to him its performance varied from poor to virtually useless.

While I had not had much practical experience in the districts he visited I realised that they were far enough away from the major stations to be well outside the primary service area. The first question I quite naturally asked was whether he used any kind of external aerial.

His reply was rather emphatic. "No," he said, "and I'd like a set which will work without my having to string wires up all over the place. If I have to go to that trouble it's not worth while. I just want a set which will play wherever I happen to be."

Yes, to him it was as simple as all that. I couldn't help mentally registering how times change and how the public come to take things for granted. Not so long ago the fact that one could pick up any signals at all in such a remote locality would have more than justified the small amount of effort needed to string a temporary aerial.

Now it must be at the touch of a button or nothing. Still, that's progress, I suppose!

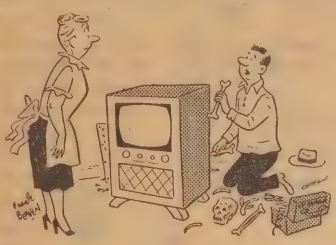
TOO MUCH?

To the owner I suggested that perhaps he was expecting too much; that it was just not possible to receive useful signals in those areas unless one was prepared to use a larger aerial. The owner felt sure this was not so. He had observed other sets in the same general locality and they always seemed capable of a better performance than his.

Then more or less as an afterthought, he added, "Some time ago this fell out." He held out his hand. "This" was a trimmer, though whether from the aerial, RF, or oscillator circuit I had no means of knowing. But whichever it was its absence would hardly improve the set's performance.

I said as much to the owner, but he stuck to his story. Certainly the set had been worse since the trimmer came off, but it had never been much good before that, not even when it was brand new. This latter point worried me somewhat. I had no desire to become involved in a set which was of fundamentally poor design, yet such would appear to be the case if the owner's observations were correct.

On the other hand it would be quite possible for a fault to have developed at some time after the set was purchased, but before it was tried in a difficult area. If so it might be relatively easy to restore the original performance; a performance which the owner had never had a chance to observe.



These ghosts on the screen. Did they show up about the time your husband disappeared? (Radio—Electronics).

As to whether there would be any point in fitting a loopstick—well, that would have to wait until the efficiency of the present loop was assessed. The most efficient loops normally fitted to modern portables are not too far behind the loopstick. On the other hand some of the smaller loops are very poor.

I'm afraid the whole question intrigued me, in spite of my better judgment. I told the owner to bring the set in and I would have a look at it.

ON THE BENCH

A couple of days later he did so and I gave it a quick once-over while he was there. It was a five-valve job, designed for both battery and mains operation, and housed in a medium-size cabinet. I was particularly interested in the latter, since it could have a bearing on the efficiency of the loop.

Tested on the air it performed quite well, at least as far as the local stations were concerned, though this gave little indication of its possible performance in remote areas.

Opening the back I had a look at the loop aerial. It wasn't a very impressive affair and I felt confident that it was responsible for at least part of the trouble. It was an oval device, measuring approximately five inches by four inches and obviously intended for use with the personal portable type of receiver.

In this respect the designer appeared to have fallen down somewhat, because the set was capable of accommodating a much larger loop. I've had enough experience of these "pip squeak" affairs to know that they are a poor proposition compared with the larger variety.

Some of the best loops I have encountered are those wound in a channel on the outside of the cabinet and underneath the leatherette. Their main disadvantages are those associated with production, since the loop has to be wound before the cabinet is covered.

If the winding is damaged during the covering process it probably won't be found until the set is fitted and finally tested. Then the whole thing has to be pulled down, the cabinet stripped, the aerial repaired and the cabinet recovered.

Also, of course, leatherette cabinets are not nearly as popular these days as they were, and plastic cabinets do not lend themselves nearly as readily to this scheme.

Nevertheless, most of the larger cabinets can still house a loop of reasonable dimensions, generally wound flat against the back, and these perform almost as well.

More lately has come the loopstick and with it many claims suggesting that it is the answer to all the problems concerning portable aerials.

OBJECTIVE VIEW

Looking at things a little more objectively than, say, the salesman of such devices, what is their position in the scheme of things? Are they better than a loop? Are they better than an external aerial? Do they, as has been suggested, pick up less static? Are they more selective?

Most of us are quite familiar with the physical form of the loopstick by now, even if the finer points of their operation eludes us. Perhaps the following details may help to fill in the gaps.

First, there is a vital difference between the operation of the conventional horizontal wire, with its earth or counterpoise, and the loop or loopstick. The former uses the transmitter's electrostatic field, while the latter uses the magnetic field. These two manifestations of the same phenomena are always present, one with the other. They cannot exist separately.

The aerial and earth operate as two plates of a capacitor, the electrostatic field creating a voltage between them. The greater the spacing the higher the voltage; thus we always try to erect our aerial as high as possible.

The loop and the loopstick operate by reason of the moving magnetic lines of force which cut the conductors. In this case our main aim is to intercept as many lines of force as possible. Which brings us right back to the problem that the size of loop we would like to use would be far too big to house in a portable cabinet.

REVERSE ACTION

The loopstick's contribution is a kind of "mountain coming to Mohammed" act, whereby it brings the magnetic lines of force into the winding, rather than spreading the winding out to intercept the lines.

It does this by reason of its very high permeability and which offers such an easy path for the magnetic lines of force, compared to the air, that they travel through it in preference to the air.

Another way of looking at it is that the rod distorts the magnetic field in exactly the same way as the core of a power transformer distorts its

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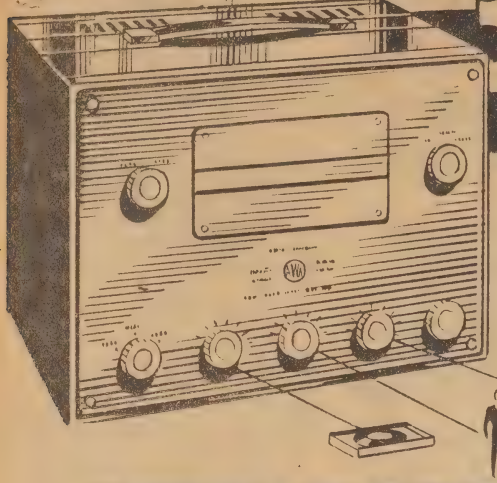

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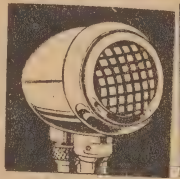

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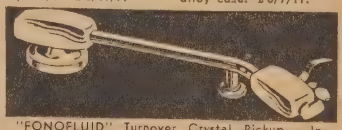

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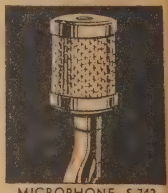

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field, keeping most of its lines in the vicinity of the winding. Without the core most of the lines would occupy a very much larger air space and relatively few would cut the winding.

Thus a very small winding on the loopstick can be made to intercept as many lines of force as a much larger winding without it.

This fact also helps in another way. Because the winding is small and because the presence of the rod increases the inductance, the resistance of the winding can be kept low for a given inductance, thereby raising the "Q" of the winding. This minimises the losses in the circuit, mainly at the resonant frequency, thus improving not only the sensitivity but also the selectivity.

As a matter of fact I understand that it is possible to make the "Q" of such windings embarrassingly high and that it is necessary to deliberately restrict this factor. This may seem rather odd when we consider the headaches engineers normally develop striving after higher and still higher "Q's", but it seems that a winding having maximum possible "Q" would cut the signal sidebands more severely than can be tolerated.

AUDIO ENERGY

This is particularly so in the case of a portable where most of the useful audio energy is around 1000 to 3000 Kc. If the top of this band is cut severely the output stage will be driven into overload at much lower frequencies (and which are generally wasted by the loud-speaker system) before use can be made of the higher frequencies.

However, by careful design it is possible to produce an optimum degree of "Q" which avoids the extreme of sideband cutting, yet contributes considerably to the preselection ahead of the converter. In this respect it may be said that these devices do improve selectivity.

Another advantage, rather more practical this time, is the ease with which they can be tuned. All loop aerials take the place of the normal aerial coil grid winding. They are tuned by a section of the tuning gang and must track exactly as does an aerial coil.

Difficulty in obtaining exactly the right inductance in a conventional loop has long been a problem, particularly as it is varied by the proximity of batteries, chassis, &c., when the cabinet is closed. It can be solved by the use of a loading coil, but this means that less than the maximum number of turns are available in the loop to be cut by the magnetic lines.

In the case of the loopstick it is simply a matter of sliding the winding along the stick until a peak is found. And it is normally quite a sharp peak, for reasons already explained.

As for the "less static" claim; well, that's probably stretching things a bit. Theoretically, the better the selectivity the less objectionable will be the various noises which are broadly classified as static and man-made static. However, the improvement in this case is likely to be more academic than anything else and would hardly mean the difference between hearing and not hearing a signal.

Summing up, then, we may say that the loopstick is at least slightly better than the best practical loop, both in sensitivity and selectivity. It is many times more sensitive than the smaller loops and also more selective. On the other hand it is not as good as a large external aerial and it has no magic properties to discriminate against static.

In somewhat less detail than I have employed above I explained these points to the owner, adding that I thought his set was a very good case for fitting a loopstick — if we could find a place to put it.

At first glance the logical place appeared to be against the inside top of the cabinet. (Loopsticks must be mounted horizontally, due to the horizontal polarisation of the magnetic field.) However, a more careful check revealed some problems. The set was mounted very close to the top of the cabinet, meaning that the aerial would have to be dismantled every time the set had to be removed.

AERIAL POSITION

In addition it would be mounted fairly close to one or two metal objects, which is undesirable, and I wasn't over keen on the position.

A better spot appeared to be on the underside of the shelf holding the set and in a clear space above the batteries. This was normally reserved for the power cord, but I noticed that this was coiled up and tied to the handle. In reply to my question the owner assured me that he never carried the power cord any other way and if I wanted the space it was OK by him.

I was about to go blithely ahead and fit the two mounting brackets at each end of the rod when it suddenly occurred to me that I had only a vague idea where the coil would be at resonance.

It was only a few minutes' work to wire it temporarily into circuit and check for resonance. It indicated that my intended position for the bracket would have fouled the coil and that a better arrangement was one at one end and one about two thirds the distance along the rod. This left the remaining third of the rod for coil adjustment.

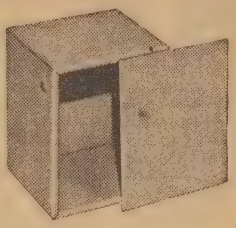
When finally mounted and adjusted the improvement in performance over the old loop was very marked. It was now possible to tune in a number of country stations in daylight, suggesting that the Sydney stations would be received just as well, or better, at a similar distance. All things considered I felt that the job had been worth while.

AERIAL COIL

One point still worried me though. In spite of the owner's lack of enthusiasm for external aerials I felt I should make the fitting of one possible in case it should be needed. I had the general idea that this could be achieved by winding a primary coil on the rod but I had no details of how many turns or what amount of coupling to use.

The owner wasn't anxious for me to spend too much time on this aspect of it so I finally suggested that he could try feeding the aerial wire through the now vacant aerial socket and winding a few turns around the rod, experimenting for best results. He was quite happy with this arrangement and departed with his set, confident that it would now provide his holiday entertainment.

METAL UTILITY CABINETS



This line of cabinet is for housing electronic equipment of all types. It has fixed back and removable front. Basic colour is grey.

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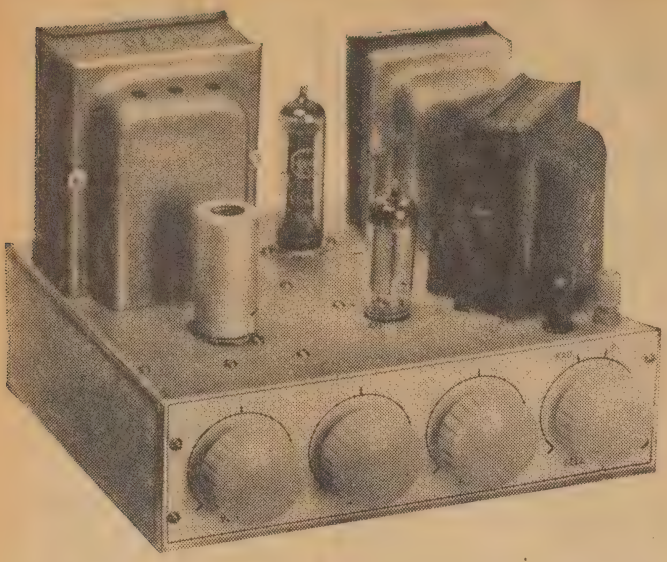


The completed amplifier. The 12AX7 is on the left, the 6BW6 on the right, and the 6V4 at the rear. Note the angle of the speaker transformer for minimum hum. Controls, left to right, are: Volume, Bass, Treble, Selector.

SMALL HIGH-QUALITY AMPLIFIER

Just to prove that you don't have to have a big amplifier in order to get first class results, here is a single-ended job that will do most things normally credited to much larger versions. If you must consider cost when contemplating an amplifier, this version may well be the answer.

by Philip Watson

THE need for this amplifier became apparent almost from the time we described the first Crystal Playmaster Amplifiers (Nos. 10 and 11, August, 1955). These proved extremely popular and it was clear that they filled a long-felt want.

Nevertheless, they were still fairly elaborate, even though simpler than previous Playmaster systems. Since not everyone can afford, or even needs, an amplifier of this type there is clearly a case for something a little less ambitious.

MAIN FEATURES

At the same time the main features of these amplifiers—the continuously variable compensation controls and their suitability for crystal pickups—have a considerable appeal to a great many enthusiasts, and there is a real need for a simple amplifier which retains these features.

As we have mentioned on previous occasions, such an approach will not suit the out-and-out enthusiast; the user of high-grade pickups (at anything up to £70 or so), elaborate—and expensive—speaker systems, and response curves exactly tailored to each recording characteristic. But it will cost only a fraction as much, and still give results much better than the average commercial radiogram.

In these circumstances we consider such an amplifier completely justified and likely to be very popular. If it makes possible enjoyable listening to someone who would otherwise have hesitated to build an amplifier, it will have served its purpose.

When we envisaged the amplifier we did not consider that it would present any particular problems. We thought in general terms of a 6BQ5 (EL84) driven by an EF86 low-noise pentode and the whole preceded by the same compensation network as used in amplifiers Nos. 10 and 11.

However, a few minutes' figuring brought us down to earth and indicated that it wasn't going to be as easy as all that. The 6BQ5 requires about four volts rms to drive it to full output. The highest gain available from the EF86 (assuming a HT of 250 volts) is about 180, making a basic sensitivity of 22 millivolts.

At first glance this looks like ample sensitivity, but we have to allow for both the loss in the tone compensation network and for the provision of a reasonable amount of feedback, say, 15 db.

Reduced to its simplest terms, and considered at 1000 cps, the compensation network may be regarded as a voltage divider consisting of the .15 and 1.5 meg resistors, with the signal taken from the junction between them. This results in loss of 11 to one, this being recovered at the low and high frequency ends of the spectrum to provide the bass and treble boost.

REAL LOSS

But for purposes of sensitivity we must regard this 11 to one loss as gone forever, and this raises the sensitivity figure to 240 mV. This would still be adequate but we have yet to add feedback. 15 db represents a voltage ratio of 5.6, which brings the sensitivity to 1.35 volts rms.

While such a sensitivity could be adequate in many cases it is very much a border-line condition. There are undoubtedly many record-pickup combinations which would be able to deliver peak voltages much higher than this, but it is equally true that there would be other combinations which would be really battling to reach this figure.

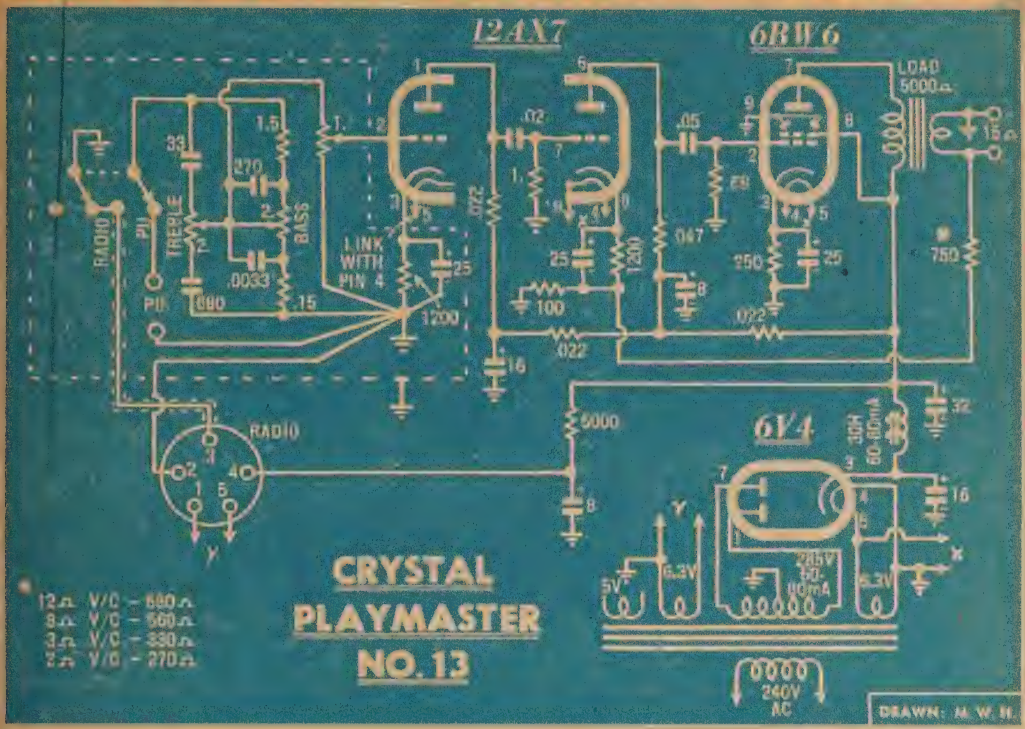
This applies particularly to some of the latest crystal pickups which, in an effort to improve the overall response, have been deliberately designed for a lower output, even though it is still much higher than the magnetic types. It is pleasing to note that this effort has been rewarded with better-than-average performance for crystal pickups.

LIGHT RECORDINGS

Such a pickup used with a lightly recorded microgroove record could easily result in an embarrassingly low output. This is all the more so because the available power is lower, for a given input voltage, than would be the case with a larger amplifier.

All things considered we decided that a figure of 500 to 600 mV (.5 to .6 volts) was the highest figure we could tolerate. Therefore, the EF86 just wasn't good enough. We considered the 6AU6 but the im-

NEW CIRCUIT COMBINES QUALITY WITH ECONOMY



The circuit tells most of the story of this amplifier. Note particularly the common earth point for the front end components and the shield to enclose all the compensation network. 80 mA power supply components are needed only if a tuner is to be used.

provement was only slight, added to which we have never been particularly keen on the 6AU6 as a valve to work under low input conditions.

Next we thought of one of the twin triodes, such as the 12AX7. Each section of this valve is capable of a gain of 54 under certain conditions, and 54 times 54 is 2900! Rather than lack of gain, such an arrangement could easily present the problem of too much gain—and how, conveniently, to get rid of it!

LOW PLATE LOADS

By reducing the plate load of each section, and particularly the first one, where only a small signal is to be handled, we were able to restrict the gain to a more reasonable amount, resulting in an initial sensitivity of 300 mV.

The possibilities of the 12AU7 were also checked at the time, and it was found that, working "flat out", it would give a sensitivity of about one volt — meaning that it was no better than the EF86 or 6AU6.

It looked like the 12AX7 under restricted conditions, and we set to work on this basis, reasoning that the 300 mV. figure would not represent more sensitivity than could be handled by the volume control.

When finally built and tested it worked out more or less as we had expected in all respects to save one. This was the matter of valve noise which turned out to be somewhat higher than we had hoped. Although not serious we didn't consider it typical "Playmaster" standard and, since we had sensitivity to spare, it seemed the logical thing to throw some of this away and reduce the noise by a proportionate amount.

Since we already had about as much feedback as could be used with safety and the plate load resistors were as low as was reasonable consistent with safety against overload, the easiest course appeared to be to change the output valve to the 6BW6 with its lower sensitivity.

This done, and the feedback network modified to allow for the reduced gain, the sensitivity finished up nicely at a little more than 600 mV. Since this represents a loss of 6 db the noise was reduced by this amount; enough to make the difference between a doubtful and an acceptable condition.

Power output is of the order of 4.5 watts, which is ample for any lounge - room, particularly with modern high sensitivity speakers. The frequency response will depend mainly on the speaker transformer, but should extend to at least 20 Kc before starting to roll off. Square wave tests of the original amplifier were very good, showing a very low order of ringing at 5 Kc.

Performance figures for the compensation network have already been published, but we give them again for the benefit of new readers. Treble boost; 11 db at 10 Kc. Treble cut; 8 db at 10 Kc. Bass boost; 8 db at 50 cps. Bass cut; 5 db at 50 cps.

On the basis that a crystal pick-up will have a natural bass boost approximately equal to that required for record compensation, the 8 db additional boost should be ample to compensate for minor variations between recordings, speaker limitations, &c.

However, don't expect the bass boost circuit to produce startling changes to the reproduction if (1) the speaker is inadequately baffled; (2) the speaker is only of mediocre quality with a naturally poor bass response; or (3) there is not a normal bass content in the particular musical item anyway. Appreciation of these points may prevent initial disappointment in the performance.

OPTIMUM FEEDBACK

The feedback factor of approximately 15 db is high enough to confer most of the benefits likely to be realised from any feedback network, yet low enough to be clear of the "danger region" where phase rotation can undo all the good work by producing positive feedback at extreme frequencies.

Summing up, then, we have what we consider is an excellent ampli-

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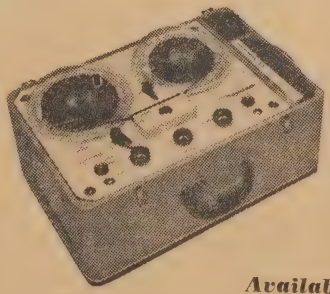

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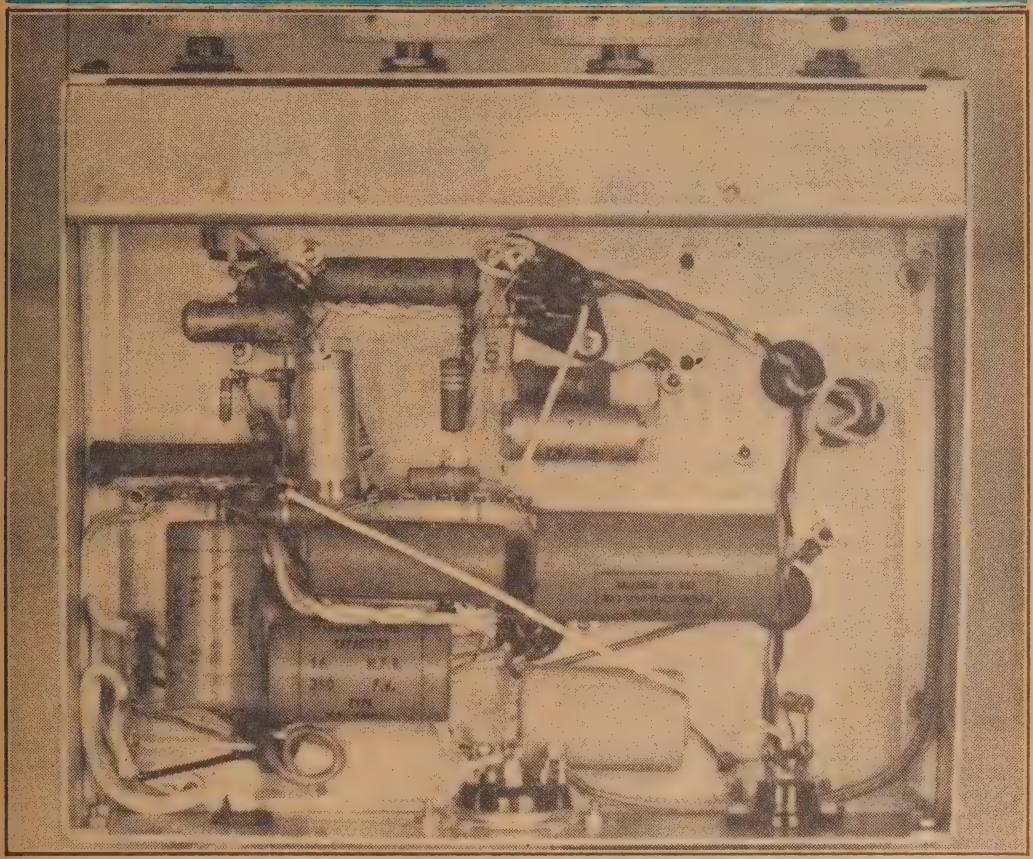
AN UNDERCHASSIS VIEW OF THE AMPLIFIER



This underchassis shot shows the placement of most of the components. The 6BW6 socket is top centre, with the 12AX7 to the left. Note the shield which completely encloses the compensation network. The volume control is on the left.

fier in its class. Ample gain for any crystal pickup, enough output for any domestic requirement, a frequency response at least better than available from most crystal pickups, and an extremely versatile compensation system. Finally, its about as economical as we can possibly make it without beginning to sacrifice performance.

CONSTRUCTION

From the general picture we now turn to a more detailed discussion of the constructional points. Although built along conventional lines, there are a few special points which need to be considered if best results are to be obtained.

The amplifier is built on a chassis measuring 8½in x 7in x 2½in. This is large enough to accommodate an 80 mA power transformer and choke, which we considered desirable, even though the amplifier itself requires only about 60 mA. The extra current rating is to take care of a tuner, and a 5 pin socket on the back of the chassis provides a means of connection. This is similar to other Playmaster Amplifiers.

If it should be felt that a tuner is not likely to be used there is no reason why a 60 mA power supply should not be used, with some saving in cost. It may even happen that a spare 60 mA transformer may be pressed into service.

The output transformer will have to be selected to suit the speaker and to reflect its impedance as 5000 ohms to the output valve. It will need to be a good quality one, and any attempt to use one of cheaper types as supplied with speakers will almost certainly lead to trouble. In addition to a lower overall performance they generally suffer from phase rotation at both ends of the spectrum sufficient to cause hopeless instability when used within a feedback loop.

Suitable transformers are available in a number of well-known brands and with a variety of secondary impedances. In most cases any one transformer will be limited to a choice of two values, the lower one being one quarter of the higher one. Thus a 15 ohm winding will have a 3.7 ohm tap, a 12.5 ohm a 3.125 ohm tap, and so on. There are good reasons why it is difficult to provide a greater variety of secondary taps on a single ended transformer.

To keep hum to a minimum we found it essential to orientate the speaker transformer until coupling with the power transformer was at a minimum. A general idea of the angle can be obtained from the photographs, but the actual position is quite critical and will vary with different transformers and mounting positions.

The correct angle is best selected using a CRO, but it can be done by ear if a CRO is not available.

CHECKING

Normal procedure is to energise the primary of the power transformer and to connect the speaker transformer (secondary) to a speaker or (primary) to a CRO. Then sit the transformer on the chassis in the position it is to occupy and rotate it until the hum pattern or signal is at a minimum. Now carefully mark the mounting holes on the chassis.

If a speaker is used, it should be

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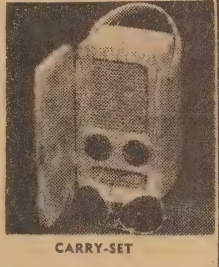

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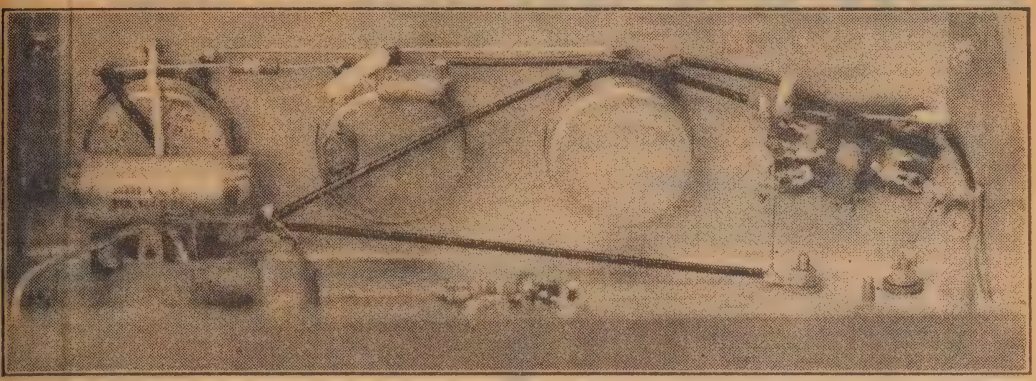
A CLOSE-UP VIEW OF THE CONTROLS AND WIRING



This picture shows details of wiring inside the shield. The volume control is on the left, then the bass, treble, and selector in that order. Near the switch is the 33 pf capacitor and the 1.5 meg. resistor. Mounted on the bass control is the 270 pf and .0033 mfd capacitors. The .15 meg. is between the bass and volume controls.

adequately baffled and no less efficient at low frequencies than the best speaker likely to be used with the amplifier. Try to select a quiet location for the test and where it is possible to hear a very low level. You will probably have to work with your ear against the speaker for best results.

Hum in the front end can also be a problem unless proper precautions are taken. The compensating network is a high impedance system operating at low signal level and is, therefore, wide open to induced hum. This is overcome by locating the entire network in a metal box, formed on two sides by the top and front of the chassis and on the remaining sides by an "L" shaped panel.

This panel is necessary for another reason. As we discovered after much futile chasing of Miller effect, there is enough capacitive coupling between the output valve plate circuit and the compensation circuit to provide considerable negatitve feedback. This, naturally, increased with frequency and amounted to something like 10 db at 10 Kc. Until we found it, it completely wrecked the amplifier's performance.

Another source of hum is earth loops in the chassis and which may be present between supposedly common earth points in the low level input circuit. To avoid this (and it can be reallyy troublesome, take our word for it!) all the critical earth connections should be returned to the same point, and these are clearly shown on the circuit.

SHIELD OPENINGS

It means that the 25 mfd cathode by-pass for the first stage is mounted inside the shield box and the cathode resistor half in and half out of it. A small cut out in the panel accommodates both the resistor and the grid lead from the volume control. Each corner of the panel is also cut to allow leads from the tuner socket to pass in to the box. One is the shielded lead to the selector switch and the other the earth lead to the common earth point.

The "L" shaped panel may be held in place in a number of ways but we used two short lengths of ¼in brass rod, slightly shorter than the depth of the chassis, and drilled and tapped 1-8in whit. at each end. The rods are fastened permanently to the bottom of the panel with countersunk screws and to the top of the chassis to hold the panel in place. It is quite easy to remove when necessary.

The use of a two-section decoupling network proved to be desirable both to eliminate the last trace of filter hum and also to eliminate a tendency to motor-boating. As is only to be expected, a single ended amplifier is more prone to both these troubles than a push-pull variety, and we deemed it a wise precaution. If you care to experiment you may find it possible to get by with one section in certain cases, but make sure it is not shocked into motor-boating on heavy signals.

READY MADE CHASSIS

We strongly recommend the use of a ready-cut chassis, since it automatically ensures a correct layout. A blueprint will be delivered to the chassis manufacturers or may be purchased by any reader who has the facilities to make his own.

Next, to ensure logical wiring, it is essential to orientate the valve sockets correctly. Using the gap between pins as a reference they should be mounted as follows: 12AX7, to the left-hand side of the chassis and slightly to the rear. 6BW6, to the rear of the chassis. 6V4, to the right of the chassis. The five-pin socket has the filament pins to the left of the chassis.

TAG STRIPS

A number of tag strips are used to support the smaller components. Inside the shield box a five-terminal strip supports the 680 pf capacitor, the 25 mfd cathode by-pass, and serves as the common earth point already mentioned.

In the main part of the chassis a five-terminal strip is used to terminate the various primary tappings on the power transformer and the power cord, using the appropriate terminals.

Another five-terminal strip near the centre of the chassis supports

PARTS LIST

1 chassis 8½ x 7 x 2½in.
1 shield (See Text).
1 Power transformer. 285V 60 or 80 mA. (See Text).
1 choke, 30 H, 60 or 80 mA. (See Text).
1 Output transformer, 5000 ohms, secondary to suit speaker.
2 Noval sockets, 1 noval socket with shield, 1 5-pin socket, 1 min. loudspeaker socket and plug.

VALVES:

1 12AX7, 1 6BW6, 1 6V4.

CAPACITORS

1 32 mfd 350 V, 2 16 mfd 350 V, 2 8 mfd 350 V, 3 25 mfd 40 V electrolytics, 1.05 mfd 400 V, 1 .02 mfd 400 V, paper capacitors, 1 .0033 mfd 1 680 pf, 1 270 pf, 1 33 pf.

RESISTORS

1 1.5 meg, 1 1. meg, 1 .68 meg, 1 .15 meg, 2 1200 ohm, 1 1000 ohm, all ½ watt. 1 .047 meg, 3 .022 meg, 1 250 ohm, all 1 watt, 1 5000 ohm, 3 watt. 2 2. meg pots, 1 1. meg pot. Feed-back resistor: See circuit diagram.

Sundries:

3 5-lug tag strips, 1 7-lug tag strip, 1 3-lug tag strip, 1 DPDT Oak type switch, nuts, bolts, solder lugs, solder, hookup wire, small quantity bare copper wire, mains flex and plug, knobs, panel, 2 spring terminals.

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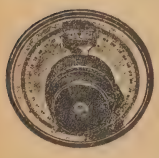

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GARRARD RC110 Record changer for 78, 45 and 33 RPM records. Will play all sizes and changes automatically both 12in and 10in intermixed if required. Fitted with high grade turn-over crystal pick-up. Finish brown.

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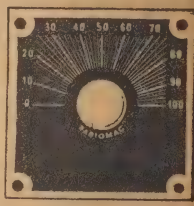

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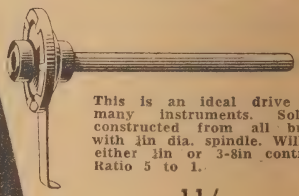

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the first decoupling resistor and one end of the second electrolytic, forming the main HT point. A seven-terminal strip with two terminals cut from one side is mounted in line with it and supports the 5000 ohm tuner decoupling resistor, one end of the second .022 decoupling resistor and its associated 16 mfd by-pass. It also provides a junction for the 1200 and 100 ohm cathode resistors for the second stage and from which runs the feedback line.

FEEDBACK RESISTORS

The feedback resistor is mounted on the miniature four-pin speaker socket, using one of the blank pins as a tie point. Naturally the correct polarity will have to be determined before the feedback circuit is permanently wired, and care should be taken to see that a large drop in level occurs when the feedback is connected. Absence of oscillation is not an infallible indication.

While on the subject don't be puzzled by the apparently low value of feedback resistor, compared with those in previous circuits. The explanation is simple: it is due to the lower gain of the amplifier section inside the feedback loop. This necessitates a higher feedback voltage for a given feedback factor.

Values of feedback resistor for other likely voice coil values are given in the circuit and, as a matter of general interest, the calculation of alternative values for this and similar circuits is not particularly difficult. Simply find the ratio of the old and new voice coil impedances, extract the square root, and the resultant will be the ratio between the existing and new feedback resistor. Naturally it is very much easier performed on a slide rule.

Certain brands of output transformer are fitted with feedback windings which are quite distinct from the voice coil winding. There are points both for and against this idea and we are not strongly biased in either direction. We did not show it as a standard connection to avoid confusing those who may purchase a different brand of transformer. However, if you do purchase one with a tertiary winding there is no reason why you should not use it.

FOR AND AGAINST

In favor of the use of a separate winding is the fact that the winding is unloaded, and therefore less prone to phase rotation than the voice coil winding. Against it is the fact that the feedback winding will present a less accurate copy of what goes on in the speaker-voice coil (due to losses in the transformer) than would the voice coil winding. So there it is; you can take your pick.

In order to use the winding it is simply a matter of earthing one side and connecting the other to the feedback line, making sure that the polarity is correct. Normal practice appears to be to make the feedback winding similar to the higher impedance secondary winding, so that the same value of feed-back resistor will be needed as would be if the voice coil winding was used. We suggest you follow the transformer manufacturer's instructions in this regard. Naturally, with this arrangement, the feed-back circuit will remain unaltered regardless of the voice coil impedance or secondary tapping used.

To make a finished job of the amplifier we recommend fitting a suitable label behind the various controls. This should be available from at least one engraving firm and may also appear as an anodised label, similar to one other design already available. We have made it similar to that required for the Nos. 10 and 11 Playmasters, in order to minimise the types of label required.

DIGITAL COMPUTER FOR SYDNEY

(Continued from page 11)

and duration of the current transfer and the position in the store from which the next instruction is to be taken.

This system avoids the loss of time which must otherwise occur if instructions are placed consecutively in the store causing the computer to halt after each operation until its next instruction is emerging from the mercury line in which it is stored.

It is therefore possible to perform all the elementary operations (addition, transfers between storage locations, &c.) in 64 microseconds.

The only exceptions are multiplication and division, which require 2 milliseconds. During this time, however, all other facilities in the machine are available for performance of other operations simultaneously with the multiplication or division.

PUNCHED CARDS

Input and output of information is on 80 column punched cards of standard type. Use of a card punch instead of a printer on the output enables the maximum speed of the computer to be utilised; subsequent sorting and printing can then be carried out on standard machinery without occupying valuable computer time.

Each input card can carry 12 instructions or up to 32 decimal digits. The latter can consist, for example, of three 9-digit numbers (each with sign) or several smaller numbers.

Input of information in sterling or other non-decimal form is also possible. The computer can convert these numbers into binary form and send them to its storage system when cards are being read at the maximum speed of 200 per minute.

The reverse process is carried out at the output, the speed in this case being 100 cards per minute, corresponding to about 50 decimal digits per second.

The problem of reliability has been attacked realistically, since it is desirable that all possible steps should be taken to avoid machine failures while computation is in progress.

VALVE FAILURES

Sudden failures of valves (of which there are about 1300), or other components, are unpredictable but fortunately occur most frequently on switching on or off, so that interruption of useful work is unlikely from this cause.

The most difficult type of fault to safeguard against is due to the slow variation of components. These can be detected in the Deuce, before their effect becomes harmful by the use of the marginal checking circuits provided.

A series of test programs is provided which test the operation of each part of the machine in turn. In the event of faulty operation the result obtained indicates immediately the nature of the fault. The fault can then be accurately located by application of the marginal checking facilities to individual elements of the suspected group of circuits.

Correct performance of the test programs under the marginal conditions, which can be applied from the control desk, ensures that the machine will operate satisfactorily during the next operating period.

"IT'S" BACK AGAIN
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A NOVEL FIELD-STRENGTH METER

The economy, small size and long life of transistors is used to good advantage in this new field-strength meter, developed recently by engineers of the Aerovox Corporation. The information should be of special interest to amateurs and others who are keen to build a comparable instrument.

THE instrument is not limited to field strength measurements; it also makes an excellent null indicator for an RF bridge; it can be applied to standing wave measurements, tuning and neutralising transmitters, and to any other operation in which a sensitive RF indicator is useful.

Schematic diagrams of field strength meters employing a crystal diode detector and a transistor DC amplifier have appeared in several publications.

The unit described in this article employs the same general scheme, but has been refined to provide much greater sensitivity, self-contained frequency range switching, and a sensitivity multiplier.

A front view of the prototype instrument. Tuning and wavechange controls are at the top of the panel, the meter zero set and range switch at the bottom. Either side of the meter is the phone jack and the "off-on" switch.

Because of the use of separate balancing current in the meter, to allow biasing on the "knee" of the transistor characteristic, the weak signal sensitivity and linearity are especially good. The application of only about 30 millivolts of RF at the antenna connector (50-ohm source) produces full-scale meter deflection on the X1 range.

Even more important, signal voltages as low as 7 millivolts produce readable deflections.

In addition to the meter indication, a phone-jack output is provided for monitoring AM signals.

The frequency range of the model is about six to 200 mc. The range varies with the type of load because of the simple direct antenna connection. However, this assumes an 8-position switch, but the lower limit could readily be extended downward by the use of a switch having 12 or more positions.

TWO BATTERIES

Two small batteries, one for the transistor and one for balancing current, are used. The drain is so low (peak of 1.5 mA and about 0.2 mA respectively) that practically shelf life is realised. Mercury cells are ideal, but the three "pen-light" cells installed in the original model have given several months of operation every day with no sign of deterioration.

The schematic diagram and parts list are shown in Fig. 1. The antenna (or other source of signal to be measured) is connected through C1 to the tuned circuit system L1-C2.

C1 is not absolutely necessary, but was used in the model to minimise chances of harm to the crystal detector or transistor through accidental application of external DC or power frequency voltages.

The tap-switch arrangement was used because of its simplicity, but other conventional methods of coupling can be employed, and some are discussed later in this article.

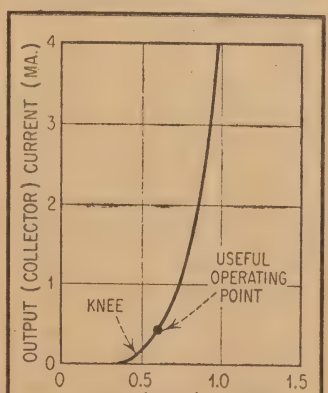
The coils, through S1, constitute the DC return path for the base-emitter circuit of the transistor.

This circuit should not be interrupted during coil switching, because the interruption would upset the balance in the meter circuit, causing the meter pointer to kick downward off scale between positions. This is why a shorting type switch must be used for S1.

The transistor used on the original instrument is a Sylvania 2N35, but any of a number of others of the low-power audio types of low cost can be employed.

The 2N35 is of the NPN junction type; if a PNP type is used, the battery connections are simply reversed.

The transistor is connected in a grounded-emitter DC amplifier circuit. Voltage divider R1-R2 biases the transistor to the "knee" of its characteristic curve for best sensitivity; for other types of transistors, some adjustment of the values of these transistors may be necessary.



TRANSISTOR CHARACTERISTIC SHOWING ADVANTAGE OF PROPER BIASING

FIG. 2

LOAD FOR DIODE

The base-emitter circuit acts as the load for a G7A crystal diode, which rectifies the input RF signal.

The battery connections are somewhat unusual, and arise from the operation of the transistor over the sensitive portion of its characteristic.

The need for biasing is illustrated in the typical transistor characteristic shown in Fig. 2. Note that the collector does not start to draw current until the base has been biased about 0.5 volts positive. Then the rise is more or less "square-law" for a short distance, then becomes rapidly more linear.

Naturally, for both sensitivity and linearity, the last portion of the curve is the one on which to operate.

Proper biasing for this is provided by the way in which battery B1 is connected. R1 and R2 form a voltage divider across B1, with the emitter connected at the negative end and the junction of these resistors grounded.

In the design of this unit, the ground tap was made variable, and the ratio of resistances adjusted so that the operating point on the curve of Fig. 2 is realised.

The voltage drop across R1 is the bias voltage for the base, making the latter positive with respect to the emitter. Since the emitter is connected to the negative terminal of the battery, the voltage applied to the collector through the meter is not affected by the voltage divider.

The biasing of the transistor to the knee of the characteristic curve makes the indication much more sensitive and the response more linear,

but results in a static current through the collector-emitter output circuit and through the meter.

With a microammeter such as used here, this static current exceeds by several times the full-scale meter rating.

To overcome this problem, the unit employs a single battery cell and control resistor in a "bucking" circuit.

The current driven backward through the meter by battery B2 overcomes the static current due to operating point bias. R4 is adjusted until the meter is returned to zero, and constitutes the "zero adjust" control of the instrument.

Because both batteries participate in the balancing of the meter, removal of either one without the other can cause meter overload. For this reason the on-off switch connects and disconnects both batteries at the same time.

THE METER

The indicating instrument employed in the model is a 150-microampere 2in model. Naturally, the more sensitive the meter, the more sensitive the instrument. However, meters with full-scale sensitivities of 50 microamperes or less are not nearly so rugged, and this should be considered in the choice.

With the 0-150 microampere meter used in the model, the sensitivity of the instrument is so great that fields anywhere in the vicinity of a transmitter, even of low power, can cause excessive deflection of the meter and overload it.

Thus, in order to provide a wide range of field strength readings, some controlled variation of sensitivity must be provided. Such control can be effected by a continuously-variable shunt across the meter, or by a switching arrangement allowing choice of any of several fixed shunts.

Because of its greater stability and potential accuracy, the latter method was employed in the model. A three-position switch allows choice of no shunt (X1), one-tenth sensitivity (X10), and one-hundredth sensitivity (X100).

The values of the two shunts depend upon the type and range of meter used; the values are 5.6 ohms and 56 ohms for the 150-microampere meter used in the model.

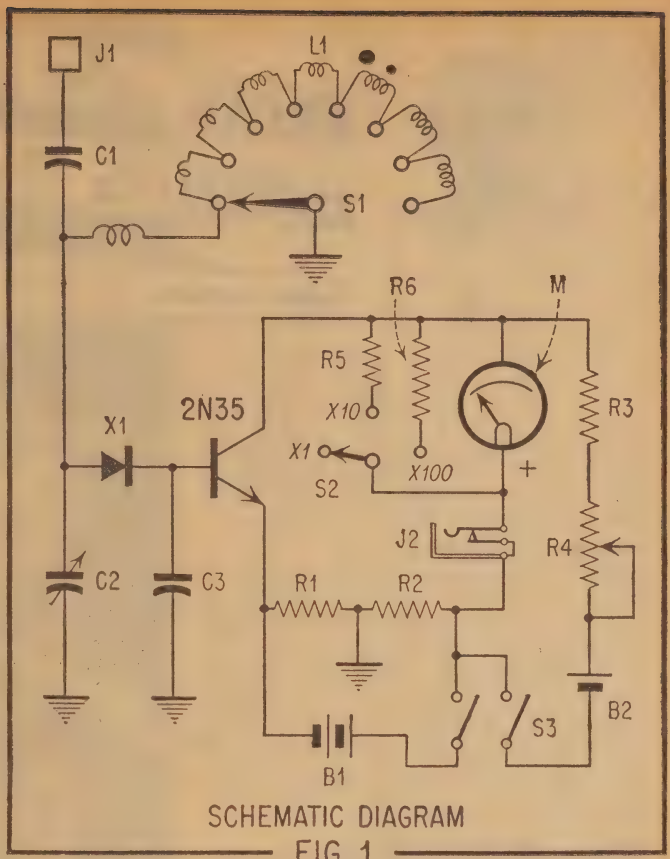
It is recommended that, if standard shunt resistors are not available, the meter resistance be used to calculate the theoretical values. Resistors just below this value can then be obtained, and "trimmed" by addition of resistance wire until the meter readings show the exact desired ratios.

BODY MOVEMENT

One practical note: Readings with an actual signal are often unstable due to the motion of the body in the field surrounding the instrument; it is therefore recommended that a d-c voltage in the order of 0.2 volts positive be applied at point b with respect to ground, and the resulting meter deflection be used to check shunts.

As previously explained, the input connection in Fig. 1 was adopted because of its simplicity in the selection of any of a number of frequency ranges. However, in some applications, a high input impedance is undesirable.

Optimum low-impedance coupling



SCHEMATIC DIAGRAM

FIG. 1

for each range can be obtained by adding another section to the switch, as illustrated in Fig. 3. A separate coupling link adjusted for best power transfer in each frequency range can then be used.

This allows connection of a transmission line to the input connector, and the use of a remote antenna, bridge or other device.

For the higher frequencies, quarter-wave rod antennas can be used, whereas for the arrangement of Fig. 1, half-wave antennas must be employed for optimum pickup.

The physical details of layout and wiring are shown in the accompanying instruments.

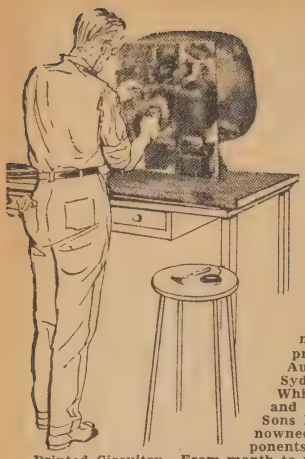
To minimise RF currents in the case, a sheet of flashing copper forms the ground return path between the variable capacitor C2 and the switch S1.

The first section of the coil is a straight piece of wire between the stator connection of the capacitor and the first tap of the switch. With the 35-uuf variable capacitor used, the highest frequency attainable in the resonant circuit is between 120 and 200 Mc., depending on the input load.

With special balanced arrangements, and a smaller capacitor, higher frequencies could be reached, but in this case the object was to obtain good operation over as wide a range of frequency as possible, hence the larger capacitor.

PARTS LIST

C1—0.001 mfd disc ceramic.
C2—35 pf maximum.
C3—0.005 mfd disc ceramic
J1—Coaxial connector.
J2—Phone jack closed circuit.
R1—2700 ohms, 5% ½W.
R2—47,000 ohms, 5% ½W.
R3—1000 ohms, 10" ½W.
R4—5000 ohms, WW control.
R5—Shunt to provide 100/1 multiplication (See text).
R6—Shunt to provide 10/1 multiplication (See text).
S1—SP, 8 pos., shorting, steatite insulation.
S2—SP, 3 pos., shorting.
S3—Toggle switch, D.P.S.T.
Transistor—NPN junction audio type (Sylvania 2N35).
X1—Germanium diode, type G7A.
B1—3 volts, "pen-light" cells or mercury type.
B2—1.5 volts, same as B1.
Case, aluminum, 7in x 5in x 3in.
L1—Coils wound to resonate over desired frequency ranges.
M—Microammeter, full scale reading from 100 to 1000 micro-A.



AEGIS ushers in AUSTRALIA'S TELEVISION YEAR

WITH DETAILS OF THEIR T.V. COMPONENTS!

In making this announcement we are proud to be linked as Australian Agents for Sydney S. Bird Ltd., Whiteley Electrical Ltd., and H. V. Enthoven & Sons Ltd., of ENGLAND renowned for Television Components and the technique of Printed Circuitry. From month to month in 1956 we shall bring you the latest developments in TV in plenty of time for you to be in the picture when TV breaks!

CYLDON "TELETUNER" Mk.II

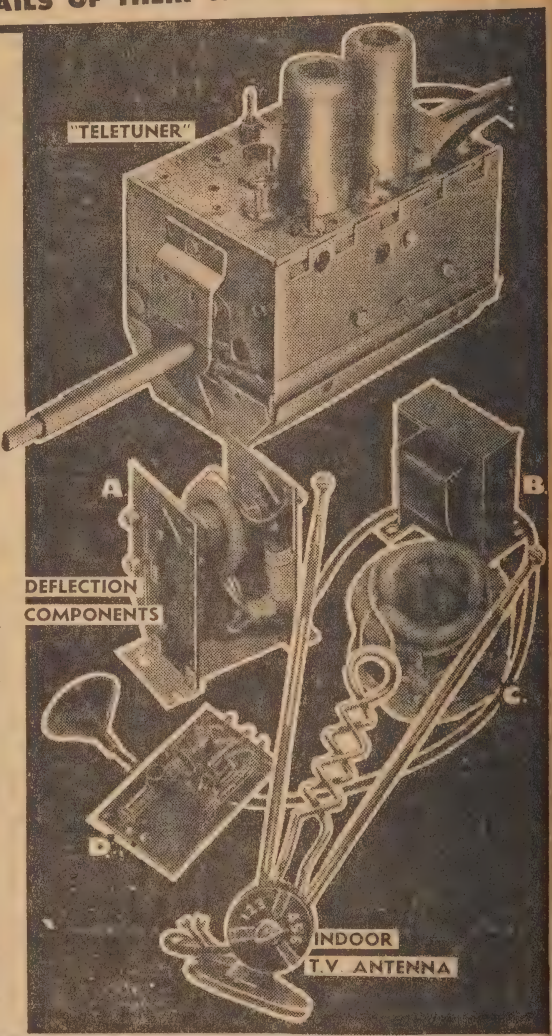
This turret tuner consists of a turret providing for 12 clip-in coil strips. When the turret is rotated, the appropriate strip locates on to a contact panel providing the necessary connection to the valves and circuit. This type of tuner construction enables the Dealer to clip in pre-aligned coils for the reception of any station not already provided for in channels 1 to 10 at the same time affording the maximum gain, minimum noise and the high stability which is required from a modern tuner. The aerial circuit is designed to accommodate either an 80 ohm balanced or unbalanced input. The first valve (PCC 84) is a double Triode Cascode. The cathode of the mixer is made available at a test point on the top of the chassis. On this the detected, over-all, response curve of the tuner may be derived with the aid of the wobbulator. Specification: I.F. Frequencies; Sound 30.5 Mc/s; Vision 36.0 Mc/s. Supply requirements: H.T. 200 volts at 35 M/A; Heaters 16 volts (subject to change) at 0.3 amp.

DEFLECTION COMPONENTS

Those illustrated are typical of the ones we shall supply. The Horizontal Line Output and E.H.T. Transformer (see A). This unit's function is to drive the horizontal, or line, deflection coils and to furnish a final anode voltage of 14 KV. to the picture tube. The Vertical Output Transformer (see B) is similar to an audio output transformer and drives the vertical deflection coils. The Deflection Yoke (see C) fits over the neck of, and hard against, the cone of the picture tube. It incorporates the vertical and horizontal deflection coils. Their combined influence upon the electron-beam within the picture tube, causes the transmitted image to be reproduced upon the face of the picture tube.
The Unit (see D) contains the Horizontal Width Control Coil and Horizontal Linearity Control Coil together with their associated circuit components. Focusing Rings (not shown) will also be available. Ion Traps will normally be supplied with the picture tube. Video and Sound I.F. Transformers will be made available either in a grouped kit or ready made up on completed and tested strips.

INDOOR T.V. ANTENNA

This all-channel antenna will eliminate outside roof antenna in many sections of the metropolitan area depending on the field strength of the transmitted signal and the freedom from electrical interference entering the house mains wiring. Outstanding features of this antenna are portability, 6-position electronic-phasing control, peak performance on all channels (both present V.H.F. and future U.H.F.), elimination of ghost images, and is equally suitable for F.M. receivers. It will still be suitable for color TV when it comes and presents an impressive appearance to the viewing receiver when placed either on or near it.



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The tuned circuit is the only one where wiring is at all critical.

All other wiring is straightforward and locations of the parts can be varied to suit.

The usual care is required in soldering both the crystal diode and the transistor, so these will not be damaged by heat. Use of long-nosed pliers as a "heat sink" is an important precaution in making connections to both of these components.

Because of the balance arrangement between currents from the two batteries previously discussed, the batteries should be connected last, and the switch S3 should be checked to make sure it is in "off" position before the battery connections are made.

ORDINARY CELLS

Although mercury cells are ideally suited to use in this instrument, ordinary "pen-light" dry batteries can also be used, with somewhat shorter life expectancy.

Because mercury cells are light and compact, they keep the weight of the instrument down, and allow space to spare in the case for other extra features which the constructor might want to add to the circuit.

With mercury cells of medium size, the current drain of the instrument is so low that practically shelf life (several years) can be expected. In fact, were it not for the balance arrangement which requires some method of removing both batteries at once for circuit changes or adjustments, the instrument could probably be left on indefinitely, with almost full shelf life from the batteries.

The development model uses "pen-light" cells, and has given about a hundred hours of service with no sign of battery deterioration.

The instrument works well with a vertical rod or "whip" antenna from several inches to 4ft long, depending upon frequency and sensitivity desired. At the higher frequencies, sensitivity will vary with how near resonance the antenna is made.

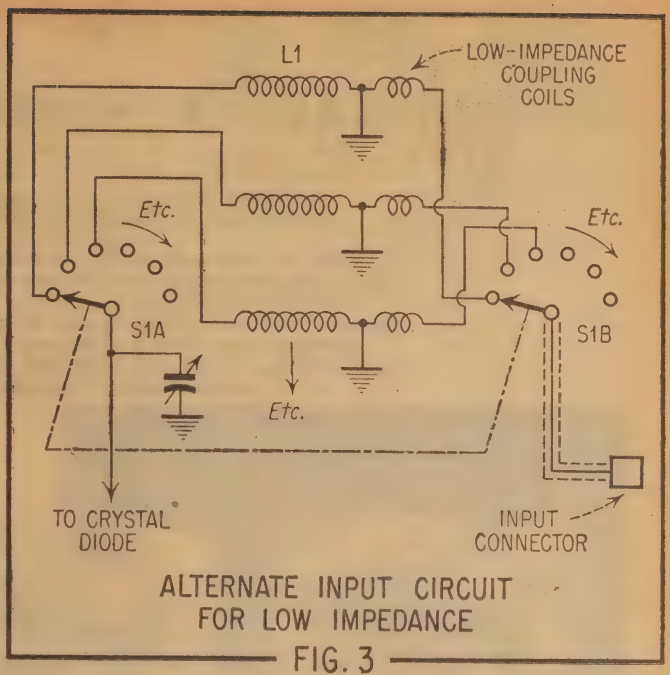
The input circuit of Fig. 1 is for high impedance, so a half-wave antenna would produce greatest pick-up, while a quarter-wave antenna would give relatively poor sensitivity.

With the alternative low-impedance input circuit suggested earlier, a quarter-wave antenna would be appropriate. The low impedance arrangement also allows connection of a transmission line, for use with a remote antenna or other signal source.

At lower frequencies (below about 70 Mc) resonant rods start to become cumbersome, and something less than a quarter-wavelength is more convenient.

The lack of resonance is partially overcome by the increase of aperture due to the larger antenna, as compared to the resonant whips for considerably higher frequencies.

Within a hundred feet or so of the antennas of transmitters of even moderately low power (50 watts output) the model has been found



ALTERNATE INPUT CIRCUIT FOR LOW IMPEDANCE

FIG. 3

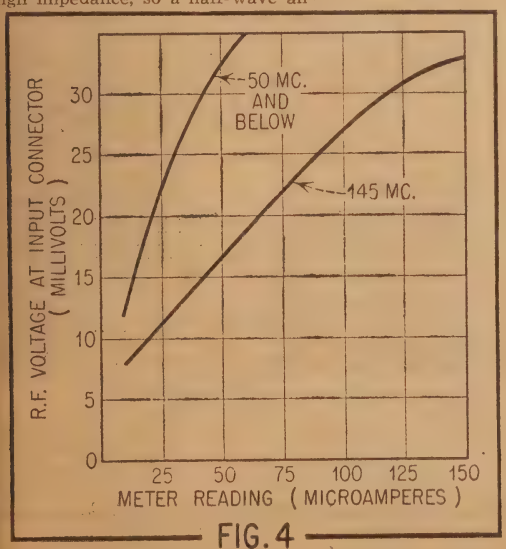
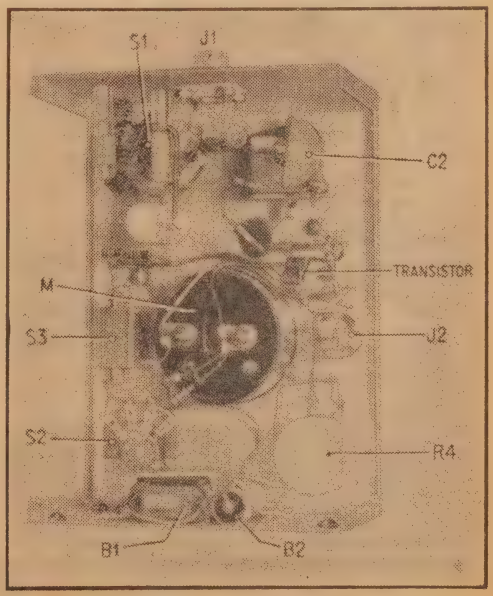


FIG. 4

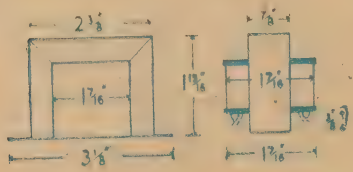


A rear view of the completed instrument.

R.C.S. release details of . . . CHOKES . . . TRANSFORMERS

Here are full details of types available in R.C.S. filter chokes, audio chokes and transformers, filament and auto transformers, speaker transformers and speaker replacement windings. It is suggested that these details be kept for reference. These R.C.S. components are both designed and manufactured in the light of latest findings in the field of electronics. Brackets are of aluminium and bobbins are of moulded polystyrene.

FILTER CHOKES AND SPEAKER TRANSFORMERS
Size: Core Section ¾in x ¾in 10 watts
o/all sizes 2½in L x 2in H x 1½in W.

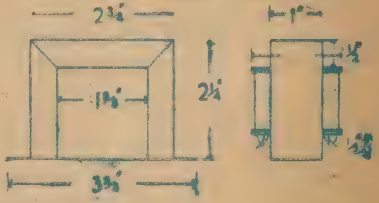


FILTER CHOKES	Retail Price
TC 66 14/60	10/6
TC 66 Windings only	6/6

SPEAKER TRANSFORMERS Type	Primary Ohm	Voice Coil Ohm	
TS 23 Single Triode	3500	2.3	16/-
TS 24 Single Triode	3500	3.9	16/-
TS 25 P/P Triode	3500	2.3	16/-
TS 26 P/P Triode	3500	3.9	16/-
TS 27 Single Pentode	5000	2.3	16/-
TS 28 Single Pentode	5000	3.9	16/-
TS 29 P/P Pentode	5000	2.3	16/-
TS 30 P/P Pentode	5000	3.9	16/-

SPEAKER REPLACEMENT WINDINGS			
F 132 Single Triode	3500	2.3	7/-
F 133 Single Triode	3500	3.9	7/-
F 134 P/P Triode	3500	2.3	7/-
F 135 P/P Triode	3500	3.9	7/-
F 136 Single Pentode	5000	2.3	7/-
F 137 Single Pentode	5000	3.9	7/-
F 138 P/P Pentode	5000	2.3	7/-
F 139 P/P Pentode	5000	3.9	7/-

CHOKES AND TRANSFORMERS
Size: Core Section 7/8in x 7/8in 15 watts
o/all sizes 2¾in L x 2in H x 1⅜in W.



FILTER CHOKES	Retail Price
TC 60 100 M/A 30 H	17/8
TC 70 75 M/A 50 H	18/-
TC 65 50 M/A 30 H	16/4
TC 58 L/T 3 amp 50 M/H Vib.	17/6

AUDIO TRANSFORMERS	
TB 42 A Class 3 to 1	27/-
TB 43 A Class p/p 3 to 1	28/-
TB 44 B Class p/p 1¾ to 1	27/-

AUDIO CHOKES	
TA 4 100 H 1000 ohms	21/-

FILAMENTS AND AUTO TRANSFORMERS	
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TP 54 4.0 v 3 amp	23/-
TP 55 6.3 v 3 amp 15 watt	20/6
TP 80 6.3 v 4 and 2.5 auto	18/-
TP 56 12.0 v 1.5 amp	23/-
TP 57 18.0 v 1.0 amp	23/-
TP 58 240 v 0.5 amp	23/-

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o give strong indications with only
n inch or two of antenna.

When signals of different but
losely-spaced frequencies are to
e measured, a non-resonant antenna
s usually desirable, because pickup
n a resonant antenna varies con-
iderably in the vicinity of reson-
nce frequency.

In field-testing the original
model, a number of checks were
nade with a 2-meter transmitter,
perating on about 147 mc. The
ransmitter was operated at about
5 watts input to the plate circuit of
he final, which was coupled to 5
alf-waves in phase, average height
f the antenna being about 20 feet.

VERY SENSITIVE

From this transmitter, conveni-
ntly-readable meter deflections
ere obtained with the model at
round level as far away as a quar-
er of a mile from the transmitting
ntenna. A 38-inch rod was used
ith the instrument.

It was found that a good practical
ntenna for the instrument can be
ade by cutting off the last two
ections of an automobile whip
ntenna, and soldering the base end
nto an 83-1SP type coaxial plug.
he latter then fits into the con-
ector on the top of the instrument
nd supports the whip. A variation
f whip length for different fre-
uencies and sensitivities is then
ossible.

The length of antenna employed
nfluences to some extent the fre-
uency range of the instrument, be-
ause of the reactance it adds to the
uned circuit. The frequency cali-
ration on the panel of the model
lustrated was made with a 1-foot
od antenna, with which the highest
esonant frequency is about 140 Mc.

However, with other antenna
ngths, the instrument can be tuned
o frequencies as high as 200 Mc.

With other types of resonant cir-
uit, the high frequency limit can
e even further extended, especi-
lly if band switching is eliminated
nd the antenna coupling method
hanged to the low-impedance
rrangement described in Part 1.

The easiest way to calibrate the
strument is in terms of millivolts
put to the antenna connector. Of
ourse, this gives no information as
the relation between field strength
nd input voltage, which depends
pon the type of antenna and the
equency. However, it does give an
dea as to the relation between
fferent readings with a given
ntenna at a given frequency.

SWITCH SECTION

Charts can be made up, correlating
eter reading to microvolts input
r each sensitivity position. A
raph giving this kind of relation at
vo frequencies for the model is
hown in Fig. 4.

In the original model, sensitivity
frequencies about 50 Mc is some-
hat greater than at lower fre-
uencies, due to the more favorable
mpedance relationships on ranges
which the inductance is small.

Readings were taken with a
boratory type signal generator of
0-ohm source impedance.

Probably, the impedance of the
enerator was shunting the diode
nd the high-impedance sensitivity
ay be somewhat better, the input
mpedance of the grounded-emitter
ansistor circuit being roughly
000 ohms.

If a calibration is desired in terms of actual field strength a reliable standard must be obtained, and the calibration accomplished through comparison.

A standard antenna (or set of antennas) must be chosen, and all of any given set of readings taken with the same one. At the higher frequencies, this is a very difficult business, because reflections, movement of the body in the vicinity, &c., cause wide variations of readings.

Such calibration should not be attempted without special equipment designed for the purpose.

The circuit and construction details given here are those of an actual model which is now giving good service. However, undoubtedly the experienced engineer will find many ways to vary the circuit to suit his own special requirements. For example, the tuned circuit may be modified to tune to higher frequencies and perhaps cover only one or two ranges.

EXTRA SWITCHING

As previously explained, addition of another section on the switch S1 will allow the use of low-impedance coupling links and greater versatility as far as impedance relations are concerned.

If relatively weak signals are not to be measured, the bucking circuit R3-R4-B2 can be removed. Then the voltage divider R1-R2 must also be removed and the negative terminal of the battery B1 grounded. This reduces the input bias to zero, and there is then approximately zero collector-emitter current and meter balancing is not necessary.

The sensitivity for very weak signals is thereby greatly reduced, but the sensitivity for moderate and strong signals is not as much affected.

The transistor is a temperature-sensitive device, so a noticeable difference in zero adjustment will be encountered if the instrument is used with widely-varying ambients. However, R4 should be of sufficient resistance to balance the meter for all but great extremes of temperature.

NEW BRITISH PLANES

THE Ministry of Supply revealed recently that aircraft production in Britain has more than doubled during the past 5 years. Today, the industry is building 2½ times as many aircraft as in 1950.

A new interceptor fighter — the possible successor to the P.1 in squadron service — was also announced. It is the Saunders-Roe S-R 53 which employs a combined rocket and turbo-jet powerplant.

The P.D.11 built by Short Bros. and Harland, is designed for vertical take-off and it is logical to suppose that development of this aeroplane will have a marked effect on the evolution of the S-R 53 and other fighter aircraft of the future.

It was also stated that the English Electric P.1——successor designate to the Hawker Hunter——and the Fairey F.D.2 research aircraft have regularly exceeded the speed of sound not only in level, but in climbing flight.

A spokesman of English Electric has stated that the P.1 first achieved supersonic climbing flight in 1954, before the French SO.9000 Trident. Security prevented the earlier disclosure of this achievement.

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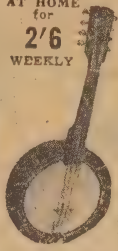

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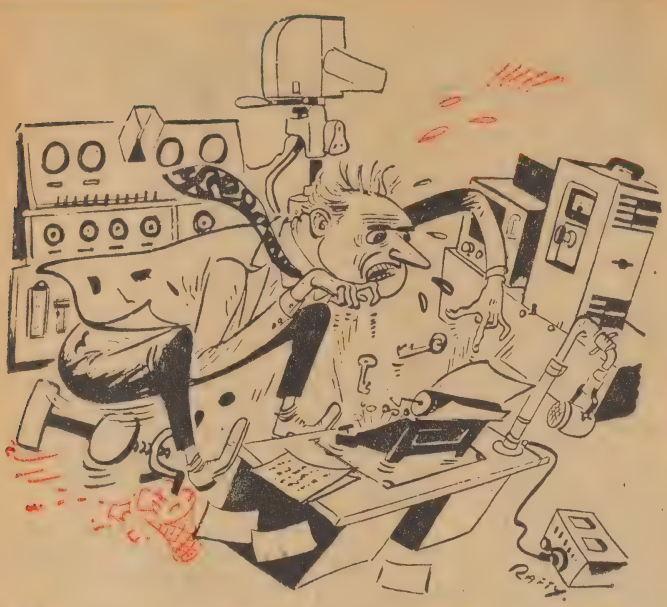


Let's Buy An Argument

Because of the intervention of holidays and schedules relating thereto, I find myself writing this instalment of "Argument" before the last issue has appeared on sale. There has been no opportunity, therefore, for readers to retort to the comment it contains about electronic organs. However, I should imagine that such comment will be forthcoming in due course.

by Neville Williams

IN the meantime, I have a mixed brew of letters on hand relating to circuit design in general.

One of them is from K.M.S., a Tasmanian reader, who begs to disagree with something we have said about modulator design. I quote:

"I feel compelled to disagree with a statement originally made in connection with the 2JU Basic Modulator, regarding peak power output being more on voice than on sine wave.

TOO MUCH SPLATTER?

"Quite apart from there being too much splatter already on the bands, due to modulator distortion products, without encouraging such things, I can't see how you come to such conclusions.

"With your experiennce of amplifiers, you will know better than I that an amplifier will overload at the same voltage point regardless of waveform.

"Of course, if the voltage regulation of the power supply is so atrocious that it can't supply the current required for more than two cycles, there may be some point in your contention. But there again that is certainly not a thing to be encouraged."

Well, it might be argued that K.M.S. is something of an idealist but I'm afraid that it could also be said that he's an alarmist!

Our remarks about the modulator in question were based on perfectly good grounds and there's no reason at all why it should produce "splatter", if properly used. In fact, some very complimentary remarks have been passed about the self-same modulator by Hams at the receiving end.

We reproduce the circuit on the opposite page for the sake of reference.

The important point about it is that it uses 807 (or 6L6) valves under somewhat extended class AB1 conditions and the full story of its design was told in the October, 1949, issue.

Similar remarks and similar circuits have been published at other times, some of which may conceivably provide a better example of the points we are about to make. However, circuit or no circuit, the general principle should be clear enough.

GOOD ECONOMY

Class AB1 operation offers a potential economy both in valve ratings and power equipment and, provided it is properly exploited, it is possible to get good value for one's money. This is ever an attractive feature for a "Ham".

Using 807's, for example, with 400 volts on the plate, 300 on the screen and a fixed bias of minus 30, the rated power output is 36 watts. With no signal input, the cathode current of the output stage is only 58 milliamps, though it rises to 159 milliamps at full signal.

Because of this wide variation in cathode current, self-bias cannot be used without, at least, some careful thought.

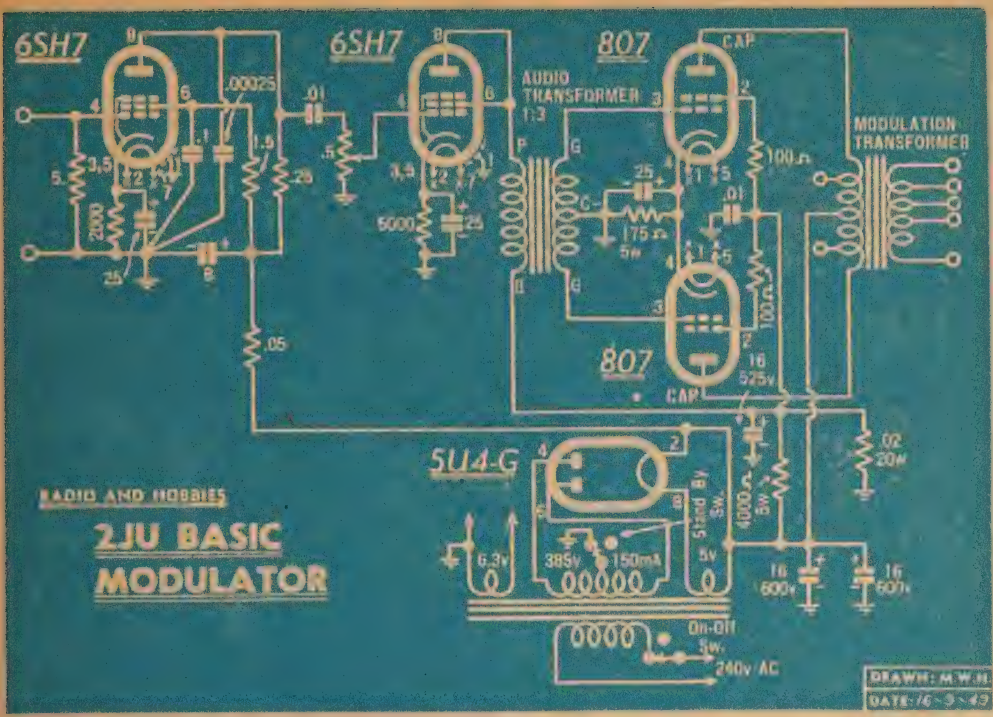
A resistor which gives the right nominal bias with no signal input allows too much bias to be generated when the cathode current rises. Conversely, a resistor which is adjusted to give optimum bias at full signal may allow so much current to flow under idle conditions that the wattage dissipation of the valves will be exceeded—either plate or screen or both.

INTERMEDIATE VALUES

For this reason, where condition are published for self-bias class AB operation, some intermediate valu of resistor is usually specified, resulting in a higher standing curren but a lower peak current with signal. As a rule, also, the figures fo optimum load and power output ar somewhat different from the fixe bias condition.

If such a stage is set up with well regulated plate and screen supply there is every reason to believe tha the quoted value of power outpu will be achieved. (We'd be askin for our money back if it couldn't!

But a "well-regulated plate an screen supply" isn't as simple as might sound in practice.



K.M.S. of Tasmania doesn't see how this modulator could deliver higher peak power on voice than it does on sine-wave input, unless "the voltage regulation of the power transformer is so atrocious . . . . . ." &c. Is the design justified?

It usually calls for a choke-input lter, involving (annoyingly enough) choke and transformer just that uch bigger and better than one er seems to have on hand. Or, they are available, the end re-lt is often enough more impress-e by its bulk than its economy.

The screen circuit presents its wn problems, and, for really good gulation, it either has to be fed om a subsidiary supply or from divider network of rather alarm-g proportions.

HE RESULT?

And the end result? Just the ted power output—nothing more, thing less.

Most amateurs tend to look at ings the other way round, and, hen designing ham gear, we try see things their way. Rather an start off with valve ratings d design a power supply they're ore likely to sort out their avail-ble power components and see how any volts and milliamps they can ax from them.

In the end they produce watts! For a modulator of this order, e assumed that they'd most likely ave a big receiver-type transfor-er, rated at 385 or 400 volts a de and at something between 125 nd 150 milliamps.

Such a transformer would not be sed with a choke input filter, be-use the final output voltage would e too low to get anything like e required power from 807's.

However, with condenser input lter, and no other resistance in circuit, it could be relied upon to deliver something over 400 volts to the 807's at full signal current.

Provided that the screen divider is adjusted up to give a nominal 300 volts and the bias resistor is correct, the full rated power should be obtained—exactly as when using the well-regulated supply that we've just been talking about.

But what happens when no signal is present?

First of all, the plate current drops and the main filter capacitors charge up to a higher standing potential.

The screen voltage sneaks up a bit and the bias comes down, both potentials being stored in the relevant capacitors.

Part of the "art" in setting up such a stage is to see that the output valves "rest" in the most advantageous condition without dissipating more than the rated plate or screen power.

AVERAGE POWER

When the operator speaks into the microphone, the average level of his voice is so much lower than the peak level, that the current through the output valves does not drain the various reservoir capacitors. Therefore, to all intents and purposes, the amplifier is operating with higher plate and screen voltages and lower bias than would otherwise be the case.

The result? Higher power output on peaks which are not of sufficiently long duration to drain the capacitors.

In practice, voice peaks are of very short duration unless the speech is subject to clipping, deliberate or otherwise.

Of course, the same peak power could be obtained by providing the amplifier with a well-regulated supply at the higher voltage—but at what extra cost.

A HORRIBLE THOUGHT

Even so, from the amateur's point of view, there's the horrible thought that, if this second power supply were allowed to deliver extra volts on no load, instead of being regulated down, the modulator would deliver even higher peak power again—on voice!

In other words, for such applications, a well-regulated power supply isn't an automatic virtue and lack of regulation isn't automatically "atrocious".

Neither can we agree that "it is certainly not a thing to be encouraged".

If further justification is needed for such an approach, it is only necessary to look at the amplifier design which has recently been sold to the world by Mullard engineers. In this, the power supply design, the standing current, the bias and the load for a couple of EL84 pentodes have been "wangled" to achieve high power output on musical peaks with the least possible drain on the constructor's pocket.

It is specifically stated that the amplifier must not be analysed on sine wave signal at a power level greater than about one watt, otherwise the shift in operating poten-

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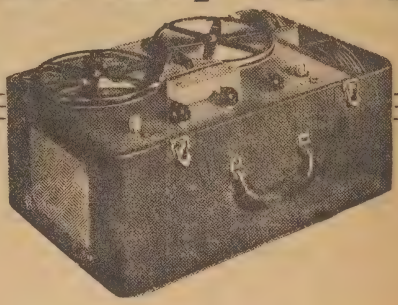

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tials upsets the designed conditions.

It is only an extension of the same principle, and it is being sold as a very high quality amplifier—not just a "hack" circuit or a Ham modulator.

Getting back to the 2JU modulator, you may recall that it uses an audio transformer to drive the output grids, rather than a resistance-coupled circuit. This, too, was quite intentional.

POSITIVE REGION

The transformer coupling helps in the matter of gain, but it also allows the grids to peak into the positive region without such an abrupt overload characteristic. It could mean extra power, depending on the lay of the loadline, and it could mean more gradual overload, with the generation of fewer and less violent harmonics.

The important thing is that the modulator worked out as we had hoped. According to our original article, it delivered 34 watts on sine wave input, which was in line with the good book. But, what was more important, by a trapesium pattern on the CRO, it proved its ability to deliver power on voice peaks markedly higher than this.

We reckoned that the "List Of Parts" had been put to good use.

This must not be interpreted, of course, as a wholesale denunciation of power supplies featuring good regulation. As one progresses toward class AB2 and class B operation, the difference between standing and peak current becomes so great that one can no longer "cash in" on the reservoir effect of the filter and bypass capacitors.

In the 60-watt modulator, described some time previously, we managed to get away with a condenser input filter, but had to specify fixed bias for the two 807 output valves. Its screen voltage, too, was pegged more securely by the drain of the divider and the plate current of the 6V6 triode driver.

GOOD REGULATION

In the 100-watt class B modulator, described about the same time, the valves operated with fixed bias and a full choke-input type plate supply. But that power transformer read blithely 750 volts per side, 150 milliamps!

The rest of the letter from K.M.S. is general in character and more of interest to us than other readers. Here are a few snippets, however:

"You often recommend running power transformers right up to the limits of their ratings, if not a little beyond, with words to the effect that a decently designed transformer would not suffer . . .

"Your audio oscillator recently described seems to be a first class job. I modified my own to your circuit and I'm well satisfied . . .

"In your control units, you were slow to use good valves. I first used a 12AT7 and you could hear people walking all over the house . . .

"Your articles on transmitters are rather elementary and far too pinch-penny . . .

"How about a really good CRO? . .

All this is good and acceptable comment on the magazine in general.

We seldom recommend taking liberties with transformer ratings, except in "Ham" transmitters and then only with good reason.

By their very use, Ham transmitters have alternative periods of rest and operation, only the filaments running continuously. Provided the high tension transformers are not grossly overloaded, therefore, they can cool between periods of operation and their average temperature should not reach danger point.

ANSWER IS OBVIOUS

If it looks like doing so, of course, the answer is obvious.

Another point to realise is that the milliamp rating of an ordinary transformer is usually quoted on the assumption of a condenser-input filter. If the same transformer is used with a choke or resistance input filter, the peak current and output voltage is reduced so that the total load wattage is less.

Thus, for the same heat rise, the load current in milliamps can be higher when using choke input than with condenser input.

We're glad K.M.S. liked our audio oscillator. It has certainly proved very popular and we have heard of several being built up for use in semi-government departments.

In regard to control units, we agree that 12AT7's can give trouble with microphony. However, it is necessary to remember that we introduced these control units in the days when the idea was relatively new to the average record enthusiast and the urge to keep them simple was a very strong one.

The supply position for twin triodes was also very patchy and we had to select the type which was most readily available to readers at the time of writing.

For all this, however, most readers were very happy with the end result.

About transmitters? Well that's a hard one. There's no field in the whole of radio where the interested parties are more likely to want to use odd parts.

It's easy enough to build up a "clever" transmitter but it isn't easy to build one that lots of other amateurs will be able to duplicate.

And the C.R.O.? We've been looking at this problem quite a bit lately and something should come of it within the next few months.

MINIMUM REQUIREMENTS

But "a really good CRO" would have to be suitable for television work and have an amplifier response to 5 or 6 megacycles. It's easy enough to say but it can't be achieved by just adding a few bits and pieces to an existing design.

Amplifiers, time base, controls, facilities, power supply — just about everything — have to be redesigned from the ground up. It may not even be advisable to use a 5BP1, for all their cheapness.

We'll know more about it later K.M.S. but, in the meantime, thanks for your letter.

A reader in Albury (R.B.) has some nice things to say about the journal but then goes on to request a general article on the elements of tone compensation, complete with simple graphs &c.

That's quite a good idea R.B. and I have a fair notion who will end up writing it!

However, our friend goes on to say that his immediate interest stems from some arguments he and his mates are having on the subject. I suggest you read his letter, set out in the panel under the heading "Tone Control".

ANY CONNECTION?

First of all, he wants to know in effect whether there is any immediate connection between treble cut and bass boost. Whether it is possible to boost bass by cutting the treble and turning up the volume?

Well, there is a rough connection between the two, which is seen at its worst in some of the sets around about town with a very drastic top-cut tone control.

As the control is turned toward its maximum cut position, the treble disappears, the volume from the receiver is lowered somewhat and the volume control is then advanced to compensate. This naturally has the effect of boosting the bass end in respect to the general listening level.

However, it isn't bass boost in the proper sense of the term because the extra volume is likely to be apparent on all frequencies from about

(Continued on Page 111)

TONE CONTROL

The following questions are causing arguments among my radio friends and I am sure that your answer will prove of interest to all constructors whose knowledge of radio is not of a professional standard.

(1) Bass Boost: Assuming that an amplifier had a top cut filter with large enough condenser values, then with the pot. at no resistance position the bass would beef out (provided the vol. control was turned up to compensate the volume drop) because of absence of high notes.

This being the case, in an amplifier with bass boost, does turning up the boost cause the bass end to become more prominent at the expense of the attenuation of high notes, or does the bass become more prominent in volume, the highs remaining the same volume and the whole range therefore becoming louder as a result? (My answer is yes!!)

(2) Why add treble boost? If an amplifier is not subject to the inclusion of various condensers here and there to limit its reproduction of highs, why then will not a simple top cut filter provide all the necessary toning down?

(3) What happens if a listener turns up both bass and treble boost at the same time? His set's volume control would do the same thing as far as result is concerned. Or does boosting of both bass and treble cause attenuation of the middle frequencies?

EXPLAINING THE MYSTERIOUS "Q"

Many a commercial fortune has been made on the glib salesman's say so that the "Q" of his product is higher than that of the opposition and whether the subject be radio receivers, transmitters or even electric power distribution it is one quantity we don't seem to be able to escape. But what exactly is Q?

by Maurice Findlay

IF you have moved at all in radio circles, several ideas come to mind when we talk about Q. We associate it with a tuned circuit and then we think of it as a measure of the tuned circuit's ability to select the required frequency. There is a link between Q and the impedance of a tuned circuit or the voltage developed across it.

The actual symbol Q may have been chosen as an abbreviation for "quality factor" and it is a very good idea to think of it as such.

It is always a sound scheme with these things to go right back to fundamentals.

The Q factor and electrical tuned circuits are inseparable, so it is to the fundamentals of a tuned circuit that we must go to make a closer study.

This tuned circuit we speak of consists of an inductance and a capacitance and both these components have very curious electrical qualities.

INDUCTIVE REACTANCE

Take the inductance first. If an alternating current source is connected across an inductor an alternating current will flow in the inductor.

The magnitude of the current depends on a quantity called inductive reactance which in turn depends on the number of turns in the coil, the shape and other factors. However, if you know the value of the inductive reactance you can calculate the current simply by dividing the applied voltage by the inductive reactance.

Unlike the current flowing in a resistor, the current flowing in a reactive element does not increase and decrease at exactly the same time as the applied voltage, because there is energy stored in the magnetic field or electric field if it is a capacitor.

In the case of a pure inductance the current magnitude always follows behind or "lags" the applied voltage by an amount equal to one quarter of a full cycle of alternating current.

A capacitor behaves in something the same way except that the current "leads" the applied voltage by a quarter cycle when a steady state has been reached.

Having firmly established these two facts some very curious ideas can be developed. If, for example, we connect an inductor and a capacitor, both with the same numerical value of reactance, in series across an alternating current generator (Fig. 1), their behavior is not at all as would be expected.

You will recall that we have already established two facts. (1) The current in the inductor lags the voltage or the voltage leads the current. (2) The voltage across the capacitor lags behind the current. In addition you will be able to see that when the inductor and capacitor are connected in series across a source of supply the same current must flow through both elements.

Perhaps the best way to understand what happens is to draw a diagram (Fig. 2). Movement in the up and down direction is used to represent amplitude while movement sideways represents time. The curve at a. represents the generator current flowing through both inductor and capacitor where the time scale is extended to the right for sufficient time for 1½ cycles to be completed. The voltage developed across the inductor is represented at b.

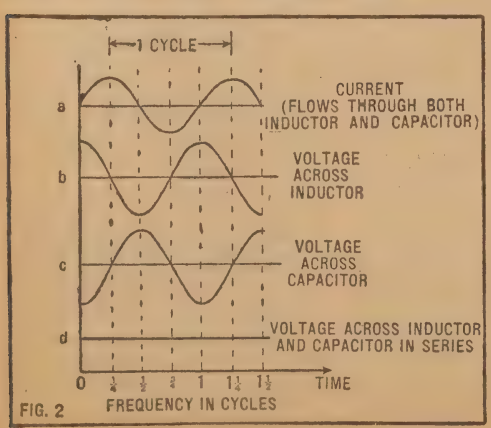

FIG. 2

It is a quarter of a cycle ahead of the current causing it when the system has had time to stabilise. At c. is represented the corresponding case for the capacitor where the voltage lags ¼ cycle behind the current.

Now to find the voltage across the inductor and capacitor in series the logical procedure is to add the instantaneous voltages. If we do this at zero time with the graph as shown, the voltage across the inductor is a maximum value positive and the voltage across the capacitor a maximum value negative. The reactances are the same so that the net result is zero.

At ¼ cycle both are zero and the result again is zero.

At ½ cycle the polarities are reversed but the result is zero once again and if you trace carefully through the diagram the result will be found to be zero at every point.

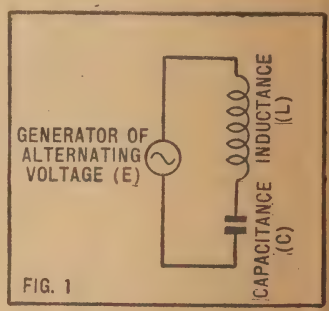

FIG. 1

Surely a surprising and an apparently illogical result!

However, that is just how it works out in practice. If you apply a low voltage to an inductor and a capacitor which both have the same reactance and are connected in series a high current will flow. At the same time high voltage will be developed across both the capacitor and the inductor.

UNEQUAL REACTANCES

To simplify the situation we have assumed so far that the inductive and capacitive reactances are exactly equal and also that the capacitance is a pure capacitance and the inductance is a pure inductance, none of which is necessarily true.

The inductive and capacitive reactances may not be the same. Say referring to Fig. 2, the inductive reactance is greater than the capacitive reactance then the voltage developed across the inductor will be greater than the voltage developed across the capacitor. That is the voltage across the capacitor will not be big enough to cancel out the voltage across the inductor and the

result will be that the circuit as a whole behaves as though the inductor had a smaller value. Leading on from this idea it is easy to see why the tuned circuit is able to select a particular frequency.

A fundamental property of an inductor is that its reactance increases with frequency. In fact, you can work out the reactance of an inductance, provided you know the value of the inductance and the frequency from the formula:

$$X_L = 2\pi fL$$

where:
X_L = inductive reactance in ohms.,
π = 3.14 approx.
f = frequency in cycles/sec.
L = inductance in henries.

In the case of a capacitor the reactance is:

$$X_c = \frac{1}{2\pi fC}$$

where:
X_c = capacitive reactance in ohms.
C = capacity in farads.
and the other symbols are the same.

In this case you can see that the larger you make f the smaller the value of Xc which is exactly the reverse of the inductive case.

If now we make the frequency of the generator in Fig. 1 variable but leave the values of inductance and capacitance fixed, the current through the circuit will start at a low value at low frequencies because the capacitive reactance is high, rise to a very high value when the two reactances are equal and then fall to a small value again at high frequencies when the inductive reactance becomes high.

If you were to work out the reactances for any pair of values of inductance and capacitance over a wide range of frequencies and for each set of values work out the current flowing in the circuit the result would be similar to that shown in Fig. 3.

Here we have been deliberately a bit vague about what happens

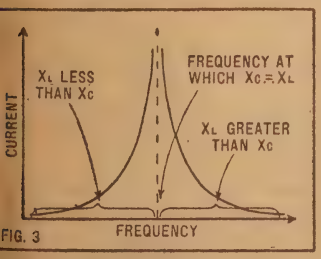

FIG. 3

when inductive and capacitive reactances are exactly equal.

In practice both the inductor and the capacitor are not perfect and also have resistance. This resistance can be considered as a small series resistor.

A well-constructed capacitor usually has low losses compared with the corresponding inductor at broadcast frequencies and in most cases

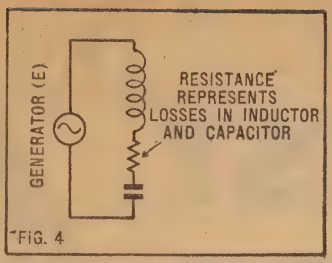

FIG. 4

the total value of resistance is close to the value contributed by the coil alone.

When this resistor is considered, the curve of Fig. 3 is transformed to that of Fig. 5 and you will note that the current no longer increases to an indefinitely high value. In fact, the current at resonance (when the two reactances are equal), can be worked out simply by dividing the applied voltage by the series resistance. As you can see from the curves, when the resistance becomes high, the maximum current is not so great and the curve loses its sharp peak.

Having come so far, we are now in a position to understand fully the meaning of Q, which can be defined as the ratio of reactance (either capacitive or inductive) to resistance.

In symbols:

$$Q = \frac{2\pi fL}{R} = \frac{1}{2\pi fCR}$$

where the symbols have the same meanings as before.

Going back to Figure 5 it isn't hard to see that the greater the ratio of reactance to resistance, and the sharper the peak at resonance the greater its amplitude.

The current at resonance is E/R and the voltage across the inductance at resonance is the inductive reactance multiplied by the current.

Then, the voltage across the inductor at resonance equals the generator voltage multiplied by the inductive reactance and divided by the equivalent series resistance. This is the same as the generator voltage multiplied by the Q.

Again in symbols:

$$\text{Voltage across L at resonance} = E\frac{2\pi fL}{R} = EQ$$

This relationship accounts for Q often being referred to as the magnification factor.

Ordinary tuning coils used in radio receivers may have Qs of 100 to 150 so that a series resonant circuit can develop a high voltage with only a small voltage applied.

Q is sometimes defined in a somewhat different way. Being related to the selectivity it is possible to work out a connection between the current at resonance and the current at frequencies a little off resonance to give a value of Q. This is approx. equal to the ratio of the frequency of resonance to the difference between the upper and lower frequencies at which the current is 0.707 times the current at resonance.

This is simpler in symbols than in words. Referring to Fig. 6.

$$Q = \frac{f_o}{f_2 - f_1}$$

(For the benefit of those who read this article with a critical eye, we would point out that different definitions of Q may lead to slightly different results.

A study of the standard textbooks such as Terman's Radio Engineering and Radiotron Designer's Handbook, is indicated for those who stand on precision. An excellent article on Q appears in Second Thoughts on Radio Theory, by Cathode Ray of Wireless World.)

The discussion so far has been confined to the series resonant circuit because the ideas are perhaps a little more straightforward, than in the parallel resonance case. Parallel resonant circuits are encountered very frequently in radio work and a discussion on Q would not be complete without some mention of them.

Referring to Fig. 7 and assuming that the frequency of the generator of alternating current, E, is variable, at low frequencies the impedance of the inductor will be low and a high lagging current will flow while at high frequencies the impedance of the capacitor will be low and a high current leading the applied voltage in phase will flow.

At a frequency between the two extremes there will be a frequency at which the lagging current being taken by the inductor and the leading current taken by the capacitor will be exactly equal. In other words the two out of phase currents will cancel out and the resultant current drawn from the power mains will be zero.

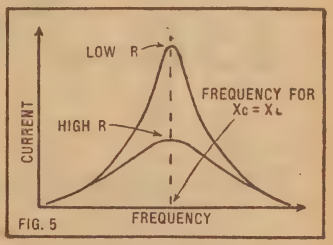

FIG. 5

Or it would be zero if both capacitor and inductor were perfect. In practice there will be some losses, again mainly in the inductor, and there will never be a case when the current is zero, although it will fall to a low value at resonance.

The residual current at resonance can be thought of as being due to a high value of resistance connected in parallel with the tuned circuit, this resistance being thought of as the impedance at resonance. It can be calculated if the reactance of the inductance and the value of its equivalent series resistance is

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known. (Again assuming a good capacitor.)

In other words, the parallel impedance of the tuned circuit becomes higher as the inductance is increased and a smaller value of capacitance used to reach resonance. But it also increases as the Q increases.

Parallel resistance at resonance

$$= \frac{(2\pi fL)^2}{R \text{ series}}$$

$$= 2\pi fL \times Q$$

$$\text{Since } Q = \frac{2\pi fL}{R \text{ series}}$$

Unfortunately, therefore ,you can't get a higher and higher impedance by keeping on increasing the inductance and decreasing the capacitance because most of the losses occur in the inductor and the Q starts to decrease at a greater rate than the inductive reactance increases after a certain point is reached.

An extreme example of this is a radio frequency choke which is designed to have as low a self-capacitance as possible. In this way the choke will have a high impedance over a wide range of freqencies. That is, the Q will be low enough for the resonance curve to be very broad.

A few specific cases of how Q affects the performance of a receiver will be of interest to practical radio men. Referring to the circuit dia-

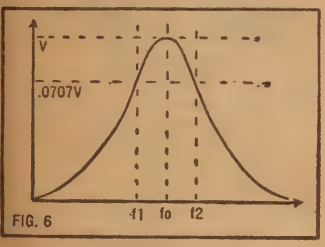

FIG. 6

gram of Fig. 8, most aerial coils these days consist of a high inductance primary loosely coupled to a tuned secondary. With this arrangement either long or short aerials can be connected without detuning the secondary. The grain can be calculated from:

$$\text{GAIN} = kQ \frac{\sqrt{L1}}{\sqrt{La}}$$

where L1 and La are secondary and primary inductances respectively and k is a coupling factor.

A high Q is therefore very desirable in an aerial coil secondary because it allows the coupling factor to be reduced while still maintaining the gain and this, in turn, permits any type of aerial to be connected and the receiver to remain correctly aligned.

Another reason for striving for high Q in a superhet is that it reduces the response to signals at the image frequency.

The behavior of the intermediate frequency transformer used to couple the mixer valve to the intermediate frequency amplifier and so on is very intimately connected with the Q. The gain is proportional to the square root of the impedance of the primary multiplied by the impedance of the secondary. In symbols:

$$\text{GAIN} = k\sqrt{Z_1 Z_2}$$

where k is a constant involving the gm of the valve or valves and the coupling factor of the windings.

As we have already seen, the impedance of both windings is proportional to Q. If we want high gain we choose the ratio of L/C to give the highest possible impedance and adjust the coupling between the windings to what is known as critical coupling.

If selectivity is the main requirement we choose a lower value of inductance and hence a higher value of capacitance to resonate at the same frequency in order to obtain a higher Q factor. Additional selectivity can be obtained by decreasing the coupling between the windings. Both measures will tend to decrease the gain.

Intermediate frequency transformers are frequently sold in three different types, known as low gain low selectivity, high gain medium selectivity and low gain high selectivity. The first characteristic is obtained by using a large inductance and a small capacitance so that the Q is low while at the same time keeping the coupling factor high.

High gain IF's have optimum impedance and critical coupling while high selectivity types use high values of C and low coupling.

The whole business can become very involved if it is attempted to write down a formula relating the number of turns, diameter and spacing of coils, &c., to gain and selectivity. Quite apart from the coils, the calculation is modified by the plate resistance of the valve feeding the transformer and the input admittance of the amplifier valve or diode detector valve being fed by the transformer.

In fact, most small coils for radio receivers are wound on a "try it and see" basis and a full analysis of the situation only attempted where a number of trial and error attempts would be too expensive, such as in the case of inductors for large transmitters and other large components.

This radio game can be really complicated!

So far we haven't said anything about measuring Q, but the method suggested by Fig. 6 is very convenient and does not involve a specialised instrument.

A vacuum tube voltmeter is connected across the tuned circuit and radio frequency energy coupled into it by means of a coil held near the inductor under test.

The method assumes that frequency can be measured accurately and that the loading of the voltmeter can be neglected. If the

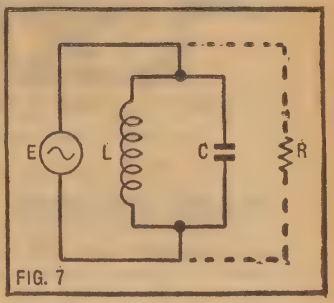

FIG. 7

initial Q is high enough there may be difficulties in measuring the frequency accurately and the VTVM loading may be appreciable. In many cases, however, a reading accurate enough to predict receiver performance can be obtained.

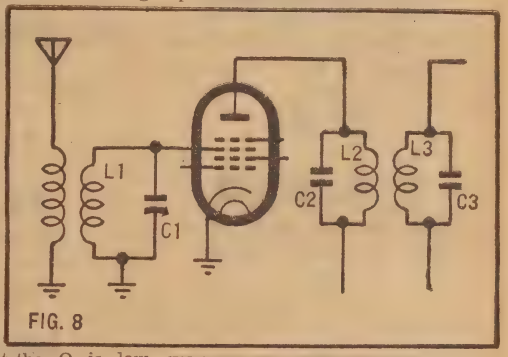

FIG. 8

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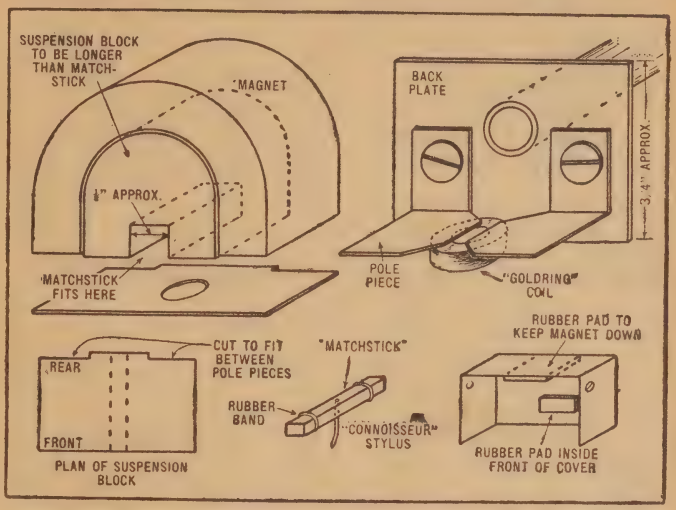
HMV MODEL 12A PICKUP MODIFIED FOR MICROGROOVE

By adding a Connoisseur type stylus assembly and a Goldring coil to an HMV model 12A pick-up, one of our readers, Mr. Bobroff, reports having contrived a very satisfactory micro-groove pickup. Other readers may care to experiment along similar lines.



Slightly larger than normal size, these sketches indicate the changes suggested by Mr. Bobroff, to convert the model 12A pickup for microgroove playing.

THE main details are given in the drawings, but our reader gives the following additional information. Two pieces have to be fabricated, the suspension block and the pressure plate.

The suspension block can be made of any light non-magnetic material such as hard rubber, fibre, or even wood. Commercial type pickups very often use a plastic moulding for the purpose.

The suspension block is made to fit inside the curve of the magnet and must be wide enough to carry the matchstick in which the Connoisseur stylus is mounted.

Care is necessary in cutting the slot in the suspension block. It is better to have the initial fit of the matchstick in the slot on the tight side. It can then be fitted accurately by shaving down the matchstick.

The pressure plate is made from thin aluminium and it is suggested that the easiest source of this is the containers of some imported cigarettes. This plate sits on the pole pieces and has a hole in its centre to allow the stylus to be passed through.

GOLDRING COIL

A Goldring coil is used in the conversion and this coil is glued to the underside of the pole pieces, as can be seen in the diagrams.

The bottom of the original cover is cut away as well as the back plate, to leave about ⅜in slot.

To the inside of the outer cover are glued two pieces of pencil eraser, one at the top to push the magnet down the other at the front to keep the suspension block in position laterally.

The completed head is held together with the two original screws. Our reader also added a small aluminium handle for ease of operation.

With regard to the stylus that will be used Mr. Bobroff makes the following remarks:

The Australian stylus is shorter than the English type but there is sufficient length for use in this modified pickup. Also with the local product it will be necessary to alter the red rubber suspension for something softer, and straighten the trailing edge angle to almost nothing. No changes are necessary with the English stylus.

Some changes were also made in the base suspension. The heavy spring was replaced for a lighter one and 5½oz of lead was used in the counterbalance tray. With these changes the tracking weight is said to be under 4 grams, and the pickup does not show any tendency to jump grooves.

For further information on the construction and modifications that have been carried out in the past on this pickup, reference should be made to the September 1951 issue of this magazine.

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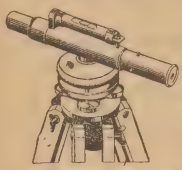

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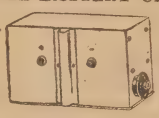

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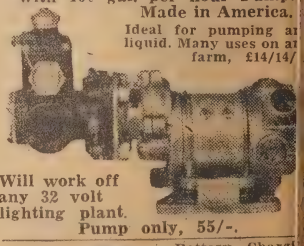

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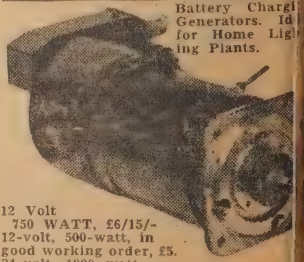

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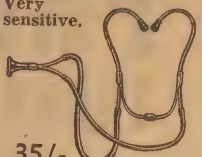

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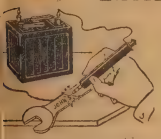

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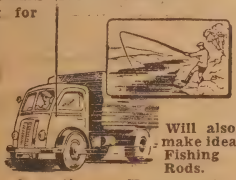

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PF 130F	230-240	285	100	6.3VCT/2A 6.3V/2A 5V/2A
PF 151	230-240	285	60	6.3V/2A 5V/2A
PF 151F	230-240	285	60	6.3V/2A 5V/2A
PF 152	230-240	285	125	6.3VCT/2A 6.3V/2A 5V/2A
PF 165	230-240	385	60	6.3V/2A 5V/2A
PF 170	230-240	285	80	6.3V/2A 6.3V/2A 5V/2A
PF 185	240	150	30	6.3V/2A
PF 201	240	225	50	6.3V/2A
PF 265	230-240	Secondary Volts		17 TAP 11.5, 10, 8.5/4.2A
PF 299	240	285	40	6.3V/2A 5V/2A

POWER TRANSFORMERS SECOND PREFERENCE

CODE NO.	PRIMARY VOLTS	HTV ASIDE	H.T. MA	FILAMENTS
PF 160	230-240	385	100	6.3V/2.5A 6.3V/2.5A 5V/2A
PF 164	230-240	325	100	6.3VCT/2A 6.3V/2A 5V/2A
PF 166	230-240	325	60	6.3V/2A 5V/2A
PF 168	230-240	385	80	6.3V/2A 6.3V/2A 5V/2A
PF 169	230-240	325	80	6.3V/2A 6.3V/2A 5V/2A
PF 173	230-240	425	175	6.3VCT/3A 6.3V/2A 5V/2A
PF 174	230-240	285	150	6.3VCT/2A 6.3V/2A 5V/2A
PF 175	230-240	385	150	6.3VCT/2A 6.3V/2A 5V/2A
PF 545	240	Ext. 1000	2	6.3V/3A 6.3V/6A
		350	20	4V TAP 2.5/2A
PF 439	240	32V	60	240-32 STEPDOWN

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CF 109	20	225	150
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CF 111	16	165	200
CF 112	10	70	250

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OP 9	15	10,000, 6600, 5000 PP	500, 250, 125	50-8000 C/S
OP 13	25	10,000, 6600, 5000 PP	500, 250, 125	50-8000 C/S
OP 24	5	5000 SE	8.4 OR 2.1	30-15,000 C/S
OP 25	15	10,000 PP	15-3.7 OR 8.4-2.1	20-30,000 C/S
OP 44	10	5000-2500 SE	500, 250, 125	50-8000 C/S
OP 54	10	5000-2500 SE	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2.	50-8000 C/S
OP 58	15	10,000, 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2.	50-8000 C/S
OP 63	15	10,000 PP	15, 3.75	30-15,000 C/S
OP 112	6	10,000 PP	2, 8 (SUIT ROLA 12 OX)	40-12,000 C/S
OP 113	6	5000 SE	2, 8	40-12,000 C/S
OP 118	6	8000 PP	2, 8	40-12,000 C/S

OUTPUT TRANSFORMERS SECOND PREFERENCE

CODE NO.	WATTS	PRIM Z	SEC. Z	RESPONSE
OP8M	15	10,000 PP	500, 250, 160, 125, 100, 83.5, 7.5, 62.5, 55, 50	50-8000 C/S
OP 17	32	10,000, 6600, 5000 PP	500, 250,125	50-8000 C/S
OP 19A	15	5000 PP	12.5, 8, 2.3	30-15,000 C/S
OP 65	15	10,000 PP	8.4, 2.1	30-15,000 C/S
OP 67	15	5000 PP	15, 6.5	20-30,000 C/S
OP117	6	5000 PP	8, 2	40-12,000 C/S
OP119	6	6600 PP	2, 8	40-12,000 C/S
OP 60	32	10,000, 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2, 2.7, 2.3, 2.	50-8000 C/S

VIBRATOR TRANSFORMERS FIRST PREFERENCE

CODE NO.	PRIM VOLTS	D.C. VOLTS	O'PUT MA	BUFFER FULL SEC.
VT 104	6	250	60	.004
VT 210	12	250	60	.006

VIBRATOR TRANSFORMERS SECOND PREFERENCE

CODE NO.	PRIM VOLTS	D.C. VOLTS	O'PUT MA	BUFFER FULL SEC.
VT 116	24	250	60	.005
VT 208	6	250	60	.01
VT 209	12	250	60	.08
VT 211	32	250	60	.005 ea. half

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TRADE REVIEWS AND RELEASES

PHILIPS' POLICY ON TV COMPONENTS

At a recent function in Sydney, the Philips organisation announced a marketing policy on a series of valves and components to meet the demands of the local television receiver industry.

MANAGING DIRECTOR of Philips Electrical Industries, Mr. F. N. Leddy, said that his company anticipated a high demand for valves and components, once the industry got under way.

The Philips organisation, through their "Miniwatt Division" planned to make available certain major components for television receivers, and manufacturers were invited to discuss their problems and schedules so that production could proceed on a planned basis.

In making available the components concerned, Philips were not aiming at "bargain prices" but were concentrating rather on quality. Experience overseas had shown that poorly designed components could lead to enormous difficulties with after-sales service.

The special components which Philips Electrical Industries would make available included a 10-channel turret tuner, a line output and EHT transformer and a composite focusing and deflection unit. These latter components would normally be designed to mate with the picture tube recommended by the company.

The picture tube in question is the MW43-64, an electro-magnetic deflection and focus type, having a rectangular screen measuring a nominal 17in from corner to corner. This was in line with the generally expressed intention of set manufacturers to concentrate initially on receivers using 17in screens.

VALVES FOR TV

The MW43-64 was to be manufactured in Australia at the Hendon factory.

Dealing with valves for television receivers, Philips engineers at the meeting nominated a range of 12 types which they claimed would adequately fill all the sockets in a typical Australian-made receiver.

The valves and their suggested applications are as follow:

6CW7, cascode RF amplifier.

6BL8 triode-pentode: Frequency changer; video amplifier and cathode-follower output; Time-base oscillator and reactance control; synch. separator and discriminator output; keyed AGC valve and noise inverter; frame synch. amp. and part of frame multivibrator.

6BX6 RF pentode: Vision IF amplifier; sound IF amplifier, video amplifier; synch. separator.

6AL5 twin diode: Video detector; ratio detector; flywheel synch. circuit discriminator.

6CK6 video output pentode.

6BM8 triode pentode: Complete audio amplifier; frame multi., and output.

6CM5 line output pentode.

6R3 booster diode.

6N3 half-wave power rectifier.

1S2 EHT rectifier.

12AU7: Multivibrator: audio amplifier.

6AU6 pentode: Sound IF amplifier; Synch. separator.

In addition to the valves, Philips also suggested the OA70 germanium diode and the 2OA72 matched germanium diodes, where these were preferred to thermionic equivalents.

Having announced the foregoing valves and components, Philips engineers then demonstrated two receivers on the equivalent of fringe-level signal strength, which indicated that excellent complete receivers could be built without going beyond the suggested range of types and therefore without complicating the valve stock position.

TWO PICTURE SIZES

One of the receivers demonstrated used a 17in picture tube, the other a 21in tube with aluminised screen. Purpose of displaying the latter receiver was to demonstrate that the same valve range could successfully be applied to larger 90-degree deflection picture tubes, if and when these are introduced on to the local market.

Both receivers used conventional power supplies but it was pointed out that the valve range had been selected with a view to a possible changeover to the transformerless type supply, which had become popular overseas in receivers using printed circuit techniques.

By simply substituting high-voltage low-current heaters in some of the valves suggested, it would be possible to change over to the alternative form of design with a minimum of change elsewhere in the circuit.

NEW PAPER TAPE IS AUSTRALIAN MADE

Under the trade name of "Aurovox", a new Australian-made paper-backed recording tape has recently been released on the local market.

THE chief attraction of a paper tape is its relative cheapness and the Aurovox tape is no exception in this regard. Current retail price for a 1200ft spool is quoted at 38/6.

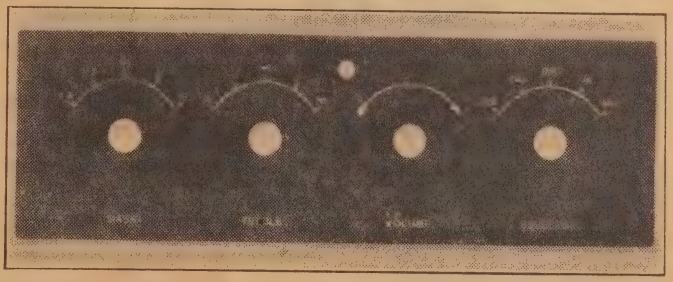
A sample reel of the tape, submitted to Radio, Television and Hobbies for test, proved to be generally better than any of the paper tapes we can recall having handled in the past. The texture of the paper is relatively smooth and the noise level on playback agreeably low.

The paper was simply loaded on to a machine that was adjusted normally for plastic tapes and performed well, without electrical or mechanical complication.

The tape is certainly not as strong as the usual plastic types but this should not lead to difficulty except, perhaps, in machines which place a heavy strain on the tape during high-speed spooling or braking operations.

Aurovox tape is available through normal dealers but, if supply difficulties are encountered, application can be made direct to the manufacturers: The Aurovox Magnetape Co., Box 33, Homebush, NSW.

ANODISED "PLAYMASTER" PLATES



Providing an attractive label for a home-made amplifier or control unit has always been something of a problem and enthusiasts will be pleased to learn of a series of anodised aluminium labels currently made available by Electronic Parts Pty. Ltd.. Types available are: Control Units Nos 4 & 6 (illustrated), Crystal Control Unit, and Amplifiers Nos. 10, 11 & 13. Price is £1-4-0 which includes tax and postage. Enquiries should be made direct to the above firm, P.O. Box 43, Broadway N.S.W.

Figure 34: In traversing the image from left to right, as indicated, a scanning spot or beam would produce a video signal somewhat similar to that represented in the graph. In a high definition system, of course, the scanning spot area would be far smaller than implied by the drawing and the modulation of the graph more detailed.

and the cell output remains con stant at some intermediate value.

Next, the scanning spot encoun ters the model's hair, which is c lighter toning than the background resulting in a slight rise in cell cur rent. This is followed by a coupl of dips in the current as the spo traverses the shadows near th model's ear.

Moving across the cheek, the ligh level is much higher, resulting in in creased cell current, as indicated except for a dip due to shadows nea the bridge of the nose.

SHADOW SIGNAL

Beyond the face, the scanning en counters a deep shadow, resulting i a rapid fall of cell current, risin gradually again to reproduce a minc highlight.

Thereafter, the output reverts t its original constant value as the spo moves past the face and hair an traverses the remainder of the mid grey background.

The reader should have no diffi culty in following an imaginary lin across any such scene or picture an visualising the way an electrical sig nal derived therefrom would rise an fall with variations in light an shade.

Figure 34 might be accepted equally well as depicting the variation in output signal from any of the camera tubes described last month, as the scanning beam sweeps across their mosaic screen.

A COURSE IN TELEVISION

PART FIVE—THE VIDEO SIGNAL

Having examined the operation of television camera tubes, it is now necessary to study more closely the kind of signal which they produce in actual operation. Without this knowledge it is impossible to appreciate the reason for many of the unfamiliar circuits found in a modern television receiver.

by W. N. Williams

WE have already shown that all television systems, whether electrical or mechanical, depend for their operation on the scanning system; that, as the light spot or scanning beam in the "camera" system traverses each separate line across the image, an electrical signal is produced in the associated circuitry proportional to the light and shade of the image.

If one were to visualise a scanning spot moving across the image depicted in figure 34, the output from a photocell receiving the reflected light might vary somewhat as the graph reproduced immediately below it.

As the spot moves from left to right along the path depicted, it traverses first a mid-grey background

It might be regarded as the bas "Video" signal—a word derived fro the Latin verb "to see". It is complementary term to "Audio" si nal, which pertains to a sound cha nel and comes from the verb " hear".

Electrically, there is a vital di ference between video and aud signals, which may as well be er phasised right at the outset.

Sound impulses are cyclic in cha acter, the air-pressure varying ra idly above and below reference. Co sequently, electrical signals deriv

therefrom (audio) are also cyclic in character, representing a mixture of alternating waves.

They can be passed through a transmitter, receiver, amplifier and loud-speaker without any special attention to phase. To the ear, the result sounds the same.

QUITE DIFFERENT

A video signal, on the other hand, is not cyclic or repetitive in character. It may be regarded rather as the variation in a DC potential, the variation being quite erratic in appearance and depending on the distribution of light and shade across the original scene.

To appreciate the difference, it is only necessary to compare the diagram in figure 34 with familiar sound and/or sine-wave patterns.

The significance of the signal is closely dependent on its sense (or phase) and its whole meaning could be changed by changing the phase, either by deriving it from another point in the generating circuit or by passing it through an amplifier stage.

Thus, where, by implication, in figure 34 the signal current is reduced in level along with the light value, the relationship could as easily be reversed, so that current increases as light decreases.

Very obviously, the relationship between light level and the "sense" of the video signal must be predetermined before transmission and the receiver designed to suit.

If this were not done, there would be a 50-50 chance of the receiver, producing highlights where there should be shadows—and vice versa —so presenting to the viewers a "negative" image.

We shall have more to say about this later.

So much for a single line.

We have seen, however, that the scanning procedure demands that line follows line in very rapid sequence, so that the basic video signal is not just for a single line as in figure 34, but for a continuous succession of such lines, following immediately one upon the other.

The question naturally arises as to how the scanning circuits in the receiver are to follow those at the transmitter. How the receiver is to "know" when to commence each new scanning line and each new scanning frame.

MECHANICAL METHODS

In the days of mechanical television, the necessary synchronisation was achieved by operating all scanning systems from synchronous motors, powered from interlocked AC mains. Apart from the problems of achieving initial synchronisation and of motor "hunting", the idea worked tolerably well.

For high-definition electronic systems, however, mains synchronisation proved impractical. Not only did it require complete interlocking of all AC power mains at all times, but it could not provide a sufficient number of unambiguous pulses to synchronise a line oscillator running at some thousands of cycles per second.

While it is still usual to make the frame or field frequency nominally the same as the mains frequency in any given country, the two are not now interlocked, and the mains supply does not play any part in synchronising the system.

Instead, synchronisation is achieved by having the transmitter radiate a predetermined pattern of synchronising pulses, which are used to "trigger" the line and frame oscillators in each and every receiver tuned to that station.

PULSE GENERATORS

The pulses are produced, in turn, by very complex and very precise synch. pulse generating circuits, provided at the studios for the purpose. The same pulses, which are radiated to control the receiver oscillators, are also utilised to deflect the scanning beam in all the cameras being used. Hence, very accurate synchronisation is possible.

The synchronising signals which are thus superimposed on the basic video signals are high-amplitide pulses of near-rectangular waveform. One such pulse is transmitted prior to the start of each new line scan, and a series of pulses to the start of each new frame or field. We shall see in later articles how the pulses are utilised in a receiver.

But, before we can pursue any further this discussion of synchronising pulses, it is necessary to look more closely at the scanning procedure and see just what the synchronising requirements are.

From earlier discussion, it will be recalled that modern television systems normally use the interlace method of scanning, and this is true of the Australian system which is our immediate concern.

In its movement across the image area, the scanning beam traces all the even lines (2, 4, 6, 8, &c.), then all the odd lines (1, 3, 5, 7, &c.) completing the whole operation 25 times per second.

Thus, while complete information about every line is presented only 25 times per second, the general outlines of the picture are filled in 50 times per second, which is sufficient of obviate normal flicker problems. This much we have already covered.

In explaining the scanning operation in the above terms, it is assumed that we are merely counting the position of the lines as they occur from top to bottom of the visible picture area.

Some textbooks adopt the alternative approach of numbering in sequence the sawtooth pulses generated by the line oscillator. They might thus suggest that lines 1 to 312 (or thereabouts) are first distributed across the picture area in one scan, lines 313 to 625 being disposed between them in the next scan.

ALTERNATIVE APPROACH

While this may be a perfectly legitimate way of explaining the operation, it does not conform to the usual practice of identifying successive scans as odd and even lines. Neither does it correspond with similar practice in locally published standards information.

Unless this point is appreciated and due allowance made for it, confusion may easily arise from the reading of different texts.

Figure 35, an elaboration of our earlier figure 13, will give a more detailed concept of interlaced scanning, though it is virtually impos-

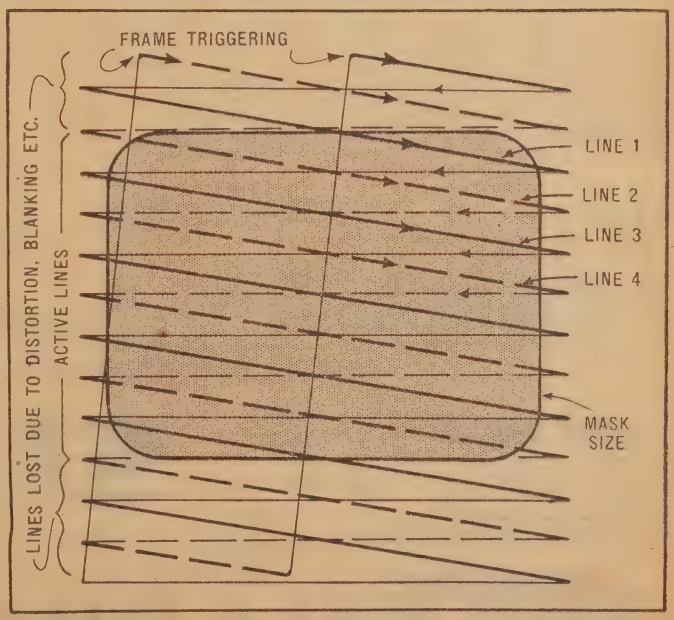


Figure 35: This diagram illustrates the scanning sequence for a normal interlaced system. The beam is blacked out when tracing lines just before and just after the framing pulse, so that not all the nominal 625 lines are usefully employed in scanning the original scene or in building the resulting image.

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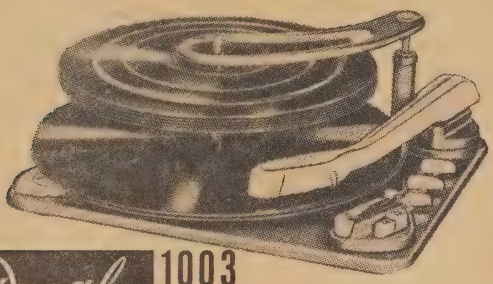

Records of all sizes (of the same groove type and turntable speed), stacked ten high, can be played fully intermixed. This is one of the advantages of the automatic glide mechanism, which works as follows: After pressing the start button, the tone arm which normally is locked into its position, unlocks, moves towards the centre of the record, sets down on its feeler, glide and moves gently to the edge of the record. The feeler is then automatically pulled in, and exposes the concealed stylus, which sets down on the run-in groove.
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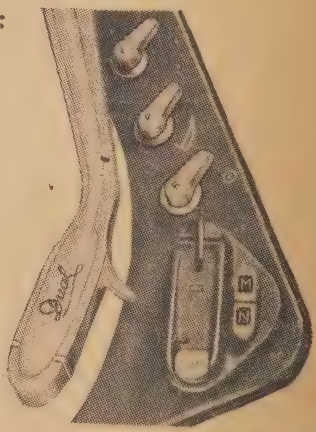

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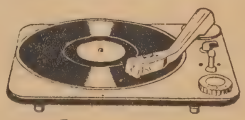

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You'll need a PLATTERRACK

sible to depict the scanning sequence accurately in such a form. It may suffice for the present, however.

Complication arises from the fact that movements of the spot are not nearly as precise as one tends to draw on paper, particularly near the end of each frame, nor does the beam always produce a visible trace on the screen.

For example, the beam is normally blacked out after each line and during the brief interval when it is flicking back to the left-hand side of the screen. This obviates the risk of random light appearing behind the main image.

FRAME RE-TRACE

The beam is again blacked out during the periods when it is being deflected back to the top of the screen to commence each new frame scan.

This is very necessary, because the frame retrace period is quite long compared with the line frequency. As a result, the last few lines of each scan are likely to be disposed haphazardly across the image area instead of preserving their precise interlaced positions, as indicated in a pencil-and-ruler sketch.

Finally, the edges and corners of the image are likely to be masked off by a suitable escutcheon in front of the picture tube face.

We have made some allowance for all this in figure 35 by outlining a picture area somewhat smaller than would be illuminated by the scanning beam, if it were not subject to the distortions and blackout periods just mentioned.

Since it is quite impractical to draw in all 625 lines, we have been content just to draw in a few lines to indicate the general path of the scanning beam.

If we assume that line 2 is the first fully visible line at the top of the image, we can trace the spot along line 2, back to line 4, then to line 6 and so on through all the even lines.

When the scanning spot has nearly completed this operation, the beam is automatically blacked out by a signal from the transmitter, during which a synchronising pulse triggers the oscillator and returns the spot to the top of the screen, thence to commence the next frame scan.

The triggering pulse for this next scan is actually timed to arrive half-way along a line, as indicated. Under the combined influence of the frame and line oscillator, the beam commences its next scanning operation across the image area, the sequence leading into line 1, as shown.

BLANKING PULSE ENDS

Half-way along this line, the black-out or "blanking" period ends and the remainder of the line becomes visible. This leads into lines 3, 5, 7 and so on, down again to the bottom of the image.

Approaching the end of the odd-line scan, the beam is again blacked out, the spot returns to the top of the picture and the frame oscillator is triggered once again, this time at the commencement of a line which ultimately leads into lines 2, 4, 6 &c.

The scanning sequence thus repeats itself indefinitely.

ADDING PULSES TO VIDEO SIG.

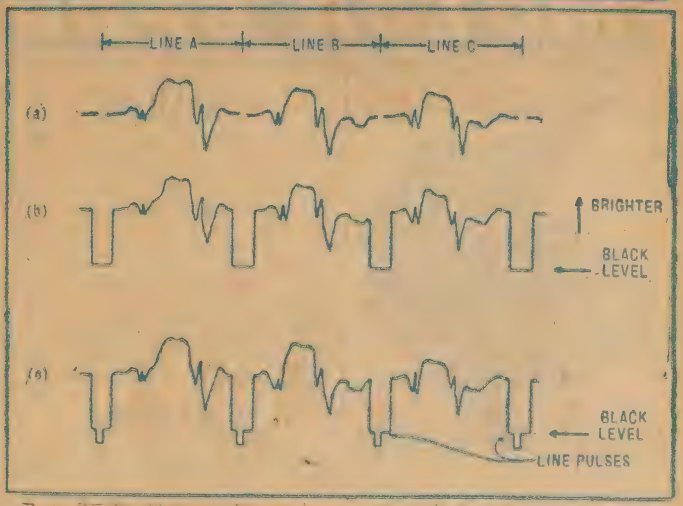

Figure 36: Illustrating (a) the video signal which might be derived from successive lines across figure 34. Sketch (b) shows the addition of blanking pulses and (c) line synchronising pulses extending into the "blacker than black" region.

Obviously enough, for a frame (or field) frequency of 50 per second, the frame oscillator must be designed to operate at about this same frequency. Normal practice is to adjust the frame oscillator for a natural frequency just below 50, so that it can be triggered readily by the frame synchronising pulses from the transmitter.

Since the line oscillator must produce 625 lines for each two frames or fields, its frequency works out at 625 x 50/2 equals 15,625 cps.

Once again, the normal practice is to adjust the oscillator for a frequency just slightly lower than this, so that it can be triggered at the appropriate time by the line synch. pulses from the distant transmitter.

From the foregoing, it will be obvious that the successive frames must be separated by the time interval equal to 312½ lines. One frame period commences at the same instant as a particular line, the next half-way along the 313th line thereafter.

PRODUCES INTERLACE

This fractional or half-line relationship between the line and frame oscillators—as indicated by the much simplified figure 35—automatically ensures that the odd and even lines lie one between the other. It also allows each oscillator to operate at an exactly constant frequency and is a better scheme than varying the frame oscillator triggering intervals to achieve a similar result.

Having ordered our thinking somewhat in regard to the scanning procedure, we can take another look at the video signal as such.

In figure 34, we derived a likely kind of video signal representing one line across a particular image. We adopted the convention that "up" on the graph corresponds to an increase in light level and a consequent increase in video signal current.

Therefore "down" infers progressively less light, through to the black level.

It is important to remember that we are discussing, at this stage, purely the video signal and that we are not concerned as yet with what happens when this signal is superimposed on a radio frequency carrier. That will come in the next article.

Figure 36a shows a succession of three video signal lines similar to the one derived in figure 34. They might well be regarded as three odd or three even lines, according to the particular frame scan involved.

BREAK BETWEEN LINES

We have shown a break between the three signals, because there must obviously be some discontinuity where the scanning beam flicks back to commence each new trace.

In fact, as we have already mentioned, if no precautions were taken against it, the flyback trace might appear behind the main image, just as it can do in an ordinary cathode-ray oscilloscope.

In the case of an oscilloscope, some attempt is normally made to black out the flyback trace by feeding a pulse from the sweep oscillator, through a small capacitor to the intensity grid of the cathode-ray tube.

In the case of a television receiver, the "blackout" pulse is supplied by the television station as part of its video signal.

Thus, just before the end of each line, a heavy pulse is superimposed on the video signal, in such a phase or sense that it cuts off the beam current completely and blacks out the return trace. The pulse is long enough in duration to allow the next line scan to start before the scanning spot is again rendered visible.

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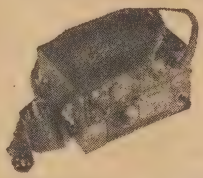

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Figure 36b illustrates the addition of line blanking (or blackout) pulses to the basic video signal of 36a. As already mentioned, these pulses are produced by special pulse generating equipment at the station and are superimposed on the basic video signal generated by the camera device, whatever form it happens to take.

It will be noted that, just prior to the start of line A, a line blanking pulse carries the video signal to a value which is equivalent to "black" and to what is often referred to as the "blanking level".

In due course, after transmission, reception and detection, this pulse appears as a signal at the intensity grid circuit of the receiving picture tube. It may be applied as a negative signal to the intensity grid or a positive signal to the cathode but, either way, it blacks out the trace for the whole duration of the pulse, preventing any pattern from being "written" on the screen.

During this interval of time, the preceding line scan finishes, the deflection fields reverse their polarity, and the next scan begins—represented in our sketch by line A.

BLANKING PULSE ENDS

An instant after line A has begun, the blanking pulse is removed and the video signal reverts to a level, which we have assumed from figure 34, to be equivalent to a mid-grey toning.

A moderate beam current is thus allowed to flow just after the line scan begins and the spot appears with an intensity equivalent to mid-grey. As the spot then sweeps rapidly across the screen to complete the whole line, its intensity varies from one instant to the next in accordance with the video signal level illustrated.

As the spot approaches the end of line A, another blanking pulse arrives from the transmitter, and the spot is again blacked out while deflection circuits complete the scan, reverse their polarity for the flyback and then begin to scan line B. Thereupon, the blanking pulse is removed and the scanning spot "writes" line B across the screen.

The same thing happens between lines B and C and between all successive lines in the frame. The presence of the blackout or blanking pulse ensures that no random pattern can appear on the viewing screen due to erratic behavior of the scanning spot adjacent to or during the flyback period.

The blanking pulses also serve another useful function in providing an electrical reference level upon which line synchronising pulses can be superimposed. The addition of these line pulses is illustrated in figure 36c.

The line synch. pulses extend beyond the video signal level corresponding to black and therefore beyond the level of the blanking pulses. They are often said to extend into the "blacker than black" region.

This rather picturesque term simply means that any signal reaching the picture tube grid, due to the synch. pulse, merely drives the grid farther beyond cut-off than it would otherwise need to go. It obviously cannot produce any visible effects on the viewing screen.

Actually the synch. pulses are intended for use by other circuits in the receiver and their application to the picture tube grid is quite incidental. They are separated out by these "other circuits", which have yet to be discussed, and applied to trigger the receiver's own deflection oscillators.

For most of the time, the signals arriving from the television station take the form illustrated in figure 36c. There are 312½ lines in each frame scan and most of them are presented in simple sequence, with just the blanking and synch. pulses interposed, as illustrated.

However, toward the end of each frame, the frame oscillator has to receive its own synchronising signal from the transmitter, and the deflection circuits have to pass through the flyback cycle to return the spot to the top of the picture area.

The operation involves a much longer time interval than the flyback period between lines. In practice, it involves about 6% of the total frame scan period, which means that about 20 lines are wasted out of the 312½ in each frame scan sequence.

A LONG INTERVAL

In other words, whereas, the inter-line blanking pulse represents a time interval of only about 2% of the duration of a single line, the inter-frame blanking pulse must be equal in duration to about 20 complete lines.

During the whole of this time, the picture tube grid must be held at cut-off, so that no random trace shall appear on the screen, due to erratic behavior of the frame deflection circuits adjacent to and during the frame retrace period.

Figure 37 shows a sector of video signal between two successive frames. It follows the convention adopted for the previous figures and refers only to the video signal, not to its graphical appearance when applied to a carrier for radiation.

On the left are two successive line scans—the last two active lines of the preceding frame.

As the last line of the preceding frame scan finishes, the inter-frame blanking pulse carries the video signal to the black level and the beam remains cut off thereafter for a period of about 20 lines.

However, even though the beam current is cut off, the line deflection circuits continue to function without interruption, so that there is no danger of any loss of synchronisation when the frame blanking pulse ends and the first line of the next frame appears on the screen.

To ensure accurate operation of the line oscillator, synchronising pulses continue right through the frame blanking period. The pulses vary in duration and detail, but they are carefully arranged so that there is always a leading edge at the exact time interval when it is required for synchronisation by the line oscillator.

Figure 37: Illustrating the nature of the video signal between successive frames. Note that the beam current is cut off for the entire inter-frame period. The actual framing signal is the five long pulses indicated.

This point can be verified by checking along figure 37, from left to right, and noting that a down stroke appears at the appropriate intervals throughout the frame blanking period.

For the sake of clarity, we have marked with a black dot the leading edges on which the line oscillator would trigger.

In between these significant pulse edges, additional pulses are added, half-way along the first seven line spaces in the inter-frame blanking period. These additional pulses do not disturb the receiver's line oscillator, because it is always so adjusted that it is not sensitive to pulses other than those which occur very close to the correct time interval.

The real purpose of these extra pulses is to provide a reference to which the framing signal can be aligned. From what we have already said, it will be recalled that the framing signal has to occur at the beginning of a line for one frame and exactly halfway along a line for the succeeding frame.

This latter requirement would obviously present a nasty problem in timing, unless there were some means of establishing the exact mid-point of the required line, to which the frame oscillator could be aligned.

DIFFICULTY OVERCOME

By inserting a brief series of half-line pulses, as illustrated, the difficulty is overcome and greater precision guaranteed in the operation of the stations pulse generating circuits. The half-line pulses are usually referred to as "equalising" pulses.

The frame synchronising signal is represented by five pulses which each occupy a much longer time interval than the normal line synch. pulses.

Because they are of longer duration, they contain a greater amount of signal energy and can be used in the receiver to charge a resistance-

(Continued on Page 112)

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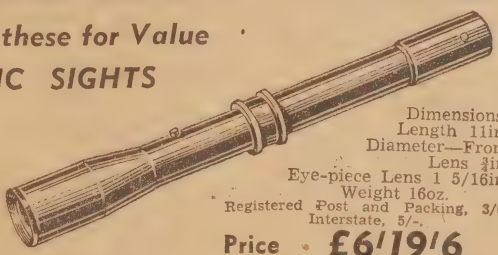

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OFF THE RECORD — NEWS & REVIEWS

Every owner of a high-grade amplifier likes to show it off—and why not? The thrill of wide-range sound is one of modern life's most rewarding things. You'll get it in full if you invest in the newly released Capitol test-demonstration record.

by John Moyle

IT has been obtainable overseas for some little time, but the comparative lateness of its Australian debut is probably due to Capitol's insistence on achieving the extremely high production standard demanded of such a disc.

As it contains pretty well every recording nightmare known to musician and engineer, it presents a nice challenge to all concerned.

It is difficult to do justice in words to the terrific sound you will hear from it.

One side contains excerpts from Capitol recordings of modern works, selected primarily to exhibit different orchestral combinations and instrumental balance.

STUDIES IN PERCUSSION

The second side performs a similar function, this time through popular music played by famous bands.

Each side has a section devoted to studies in percussion, in which you will hear a riot of transients to test your equipment—and the neighbor's ears—to the uttermost.

Don't be upset if the fine edges don't completely emerge—only the finest gear will take the lot without a flaw. The boys who meant this as a test record weren't fooling, but they have done their part.

The percussion studies are possibly the most striking and realistic sections of all.

The pop side carries the heaviest recording, and its impact is greater than the combinations on the reverse. Les Paul and his guitar contribute a highlight.

The more serious side, because of the lower amplitude, shows up the only minor criticism I have—a few surface crackles audible when the music isn't there. The other side is entirely quiet. Nevertheless, where superlative recording is on sale, even this small point must be mentioned.

Nevertheless I have heard an imported pressing of this disc, and I consider the local job in every way its equal. I can only congratulate Capitol heartily on its issue.

One strange omission is the human voice. The sound is almost entirely instrumental.

The disc comes in a box with an attractively printed booklet which tells you much about hi-fi and the disc. It also has a copy of the recording curve which would appear to be the AES on which I played it back.

MOZART—Concerto No. 14 in E flat major, for piano and orchestra (K499); RICHARD STRAUSS—Burleske. Played by Frederick Gulda and the London Symphony Orchestra conducted by Anthony Collins. Decca LXT5013.

This is the first time I have heard the Strauss Burleske, but it's easy to see in it the work of the composer, barely 21 years, already aware of his power to create musical excitement, but not yet writing in the style that was to make many hail him as the ultimate musician—the man who could do anything.

It is obvious that both Gulda and Collins revel in this music, and they have made it a brilliant thing.

Nor have the recording engineers been less successful. The piano rings out with great effect, whether handling a delicate arabesque or building up full power. The orchestra, too, is first rate.

Incidentally, you won't miss several references to later and famous tone poems in the Burleske.

The Mozart doesn't languish by any means—it is played firmly and seriously, and stands the treatment very well.

I thought maybe it could have been worked over a little bit more and I'm sure both conductor and pianist could have turned some of the corners more gracefully.

On the other hand I played a couple of versions of this concerto I have on hand, and I'd settle for it against the field without much hesitation.

Altogether, this is a nice record with no surface noise. I liked the AES curve better than Decca's on which it sounded a fraction edgy. But no one could complain of the disc up to this standard.

MENDELSSOHN OVERTURES —Fingal's Cave, Fair Melusina, Ruy Blas and Calm Seas and Prosperous Voyage. Played by the Vienna Philharmonic Orchestra conducted by Carl Schuricht. Decca LXA2961.

This is a good refresher for those who tend to overlook or discount Mendelssohn. Each of these overtures is different and individual. Each is filled to the brim with music and color—not the color of exploited orchestral sound, but the interplay of melody and joyous shouts of drama and romance.

There is an irresistible quality about Mendelssohn, found no more clearly in these overtures—an inner radiance which springs from a clear and joyous mind. Very few composers have achieved it in just the same measure.

This is a smooth and spacious recording which goes down well. I doubt whether it is recent—I'd date it at least two years back. It hasn't quite the definition of Decca's best, and my pressing wasn't absolutely clean by wide range standards. This applies more particularly to Ruy Blas. One side has a bit too much surface to be completely successful on Decca's compensation. I thought it sounded best—and very fine—on the NAB setting. A few groove echoes, particularly in Ruy Blas.

The performances are admirable i

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every way. Nothing I have said should put you off it. It is played with zest and warmth, and with full appreciation of those broad sweeping moments which the composer achieves so well.

GIPSY MELODIES — Songs and Instrumental pieces by Ilonka Becsi (soprano), and Lendvay Kalman's Gipsy Orchestra. Philips NOO727.

I can claim no knowledge of the authenticity or otherwise of this record as Gipsy music, but I can only say this is unlike any other such record I have heard to date.

On one side we have a number of Hungarian songs arranged in something like a song cycle, and sung most fetchingly by Ilonka Becsi, a facile soprano, who has achieved much fame in Europe for work of this kind.

On the other side a number of instrumental pieces are strung together, featuring typical violins, as well as the cymbalo and clarinet, which I had never thought of as a gipsy instrument.

Listening to the cymbalo, however, it's not hard to see where Liszt got his idea for the Hungarian Rhapsodies as piano solos.

The recording is of good quality, and I suppose it is characteristic to maintain such an unvarying volume and tempo.

A record which you shouldn't miss if Gipsy music is your weakness.

TCHAIKOWSKY — Symphony No. 6 in B Minor Opus 74 (Pathetique) played by the Chicago Symphony Orchestra conducted by Rafael Kubelik Mercury MG50006.

In power and force this recording completely eclipses any Tchaikowsky Sixth I have ever heard.

In common with several Mercurys I have received this month, it has the studio's signature all over it.

The performance is given with the greatest intensity. Throughout the orchestra is tautly keyed to a high pitch, and the recording has set it all down with a razor edge.

There is less subtlety in it than will be found in other versions. There is no loving hand or sentimental scooping here. Instead we have a drive that cuts the air like a whiplash, broad shaping and terrific contrasts that build mountains of sound, steep dynamic gradients which rise from a whisper into tremendous pinnacles of power.

In my mind this is a perfectly legitimate approach to Tchaikowsky, whose music was made on just those things. This, his finest symphony, is as uninhibited emotionally as anything could be, and to play it with any touch of coyness or reserve is to miss its spirit.

CRYSTAL CLEAR

Kubelik and his players have made of it a brilliant piece of crystal-clear, modern virtuosity. By comparison, the sound of its competitors, even the best of them, sounds dull.

This is true particularly of the brass, and in the precision of those sudden fortissimos scattered throughout the work.

It is wide-range, not merely as a display in piercing sounds, but with a clean, immediate air which as I have said is typical of Mercury. This atmosphere pierces a more than average reverberation, an appreciable degree of which is essential to preserve the effect that a powerful orchestra is playing all the time, even in the quietest passages of its extraordinary dynamic range, obtained, incidentally, with no sign of groove echoes.

Undoubtedly it is a record for big machines, able to handle the big sounds without washing out on the soft ones.

I liked it on the AES setting, which, despite the edge of strings and shiver of brass, gives realism and authenticity but no distortion.

Only the surface disappointed me in patches, mainly because the prefered high level playback provides a stringent test. On the other hand there are sections which are quite OK. But for this I would have been fingering the five stars.

BRAHMS — Symphony No. 1 in C Minor Opus 68. Played by the Chicago Symphony Orchestra conducted by Rafael Kubelik. Mercury MG50007.

Very high marks are scored by this record. Its beautiful clarity of sound, cleanly disciplined playing, and near perfect instrumental balance are not bettered by any other recording of this symphony I have heard to date.

Its nearest competitor would be the Cantelli version for HMV, which is in quieter mood. Its contrasts, while quite vivid in their way, do not equal those of the Chicago, and the reproduction is dull and heavy by comparison.

As in the Tchaikowsky Pathetique, the new disc achieves a big concert atmosphere without sacrifice of presence, something that Mercury have worked out most impressively. And once again we have that phenomenal dynamic range without any of the distress signals so often heard.

The performance is probably most noticeable for its use of these broad dynamic effects. This gives the music a wide, sweeping shape which fits admirably with its strongly colored score. I have heard other interpretations which revealed more carefully handled inner sections, but none which have achieved the same over-all magnitude, or which left me with the same sense of weight and stature. If you have a big amplifier and a big room it will give you easily the greatest musical impact.

The recording has an extremely high amplitude which renders a rather less than perfect surface of lesser importance.

RACHMANINOFF—Symphony No. 3 in A Minor, Opus 44—Vocalise Opus 34, No. 14. Played by the Philadelphia Orchestra, conducted by Eugene Ormandy. Philips AO1156L.

Rachmaninoff's third symphony might not be recognised immediately by anyone with a fixation from the piano concertos and earlier symphonies.

It has just as much if not more powerful drama and romantic pull, but there is less of an adolescent yearning about it. The melodies aren't quite as heart-searching as they were.

No doubt Rachmaninoff had reached somewhat more mature emotional waters. Only occasionally do we relive the falling cadence and strongly emotional colors so familiar to all. You will encounter new moods in this music, and at times a light-heartedness which previously had only been hinted at.

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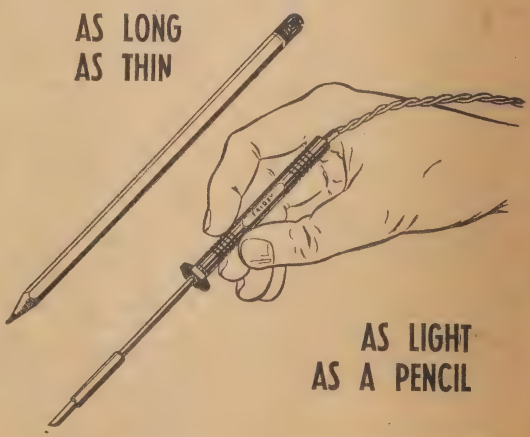

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by Ormandy, Rachmaninoff had a close link with and a great admiration for the Philadelphia Orchestra, and this interpretation must therefore be considered as particularly authentic.

It certainly produces some fine playing, and is finely recorded on this disc.

The famous string tone is there, including the 'cellos which sing just as resonantly as of yore.

The second movement is particularly well done. Throughout it is forwarded and warmly rounded. You will also hear the breath drawn by the horn-player in the first few bars if your equipment has wide range.

Exquisitely played is the Vocalise, familiar to most people, and perfect material for the Philadelphians and their lovely string section.

The surface is quiet. Dynamic range is quite wide. The bass is full and taut when required, the top end has a bloom and a gracious quality of which Ormandy has made the most. Frequency range is good.

Yes, there is some excellent music on this disc.

ALBINEZ—From the Suite Espagnole, orchestral pieces arranged for orchestra. Played by the Orquesta Lirica Audio Museum, Madrid. Radiola Telefunken NLB6089.

Nobody can well resist the color of this music by a composer more traditionally representative of Spain than any other. Some of the pieces will be familiar and most have a folk tune air coupled with the unmistakable Spanish rhythms.

Although the orchestra comes from Madrid, I did look for more animation and zest than I heard.

It would have quickened the blood more successfully with a little less care and a little more abandon.

But it is very pleasant listening for all that, and has a nice quiet surface to boot.

LEHAR—Excerpts from The Land of Smiles and Paganini. Sung by Gerda Scheyrer, Freidl Poltinger, Walter Anton Dotzer and Toni Neissner, with the Vienna Broadcasting Orchestra conducted by Heinz Sandauer Philips. P10109R.

Lehar's irresistible music and a better than average quality batch of singers help to make this a most pleasant disc.

It is true that the singing isn't up to the quality of the recently released Columbia Land of Smiles, and in honesty that would be an extremely difficult task.

But the tenor sings warmly and sympathetically, and the soprano, despite a tendency to run slightly off in the top register, does well, too.

The orchestra provides admirable support and the atmosphere is definitely theatre rather than studio. It is well ahead of the average recording of excerpts from this and that. A quiet surface helps greatly in winning that approval.

RAVEL—L'Enfant et les Sortileges. Performed by l'Orchestre de la Suisse Romande and the Motet Choir of Geneva with soloists. Conducted by Ernest Ansermet. Decca LXT5019.

This is a story in sound about a naughty child with sadistic tendencies who, after having being reproved and punished by its mother, indulges in an orgy of destruction involving everything from the wallpaper to the cat, only to have the objects of its assault brought to life by magic so that they may express their not unnatural feelings of disgust and loathing for the little monster.

However, one kind act in tending a squirrel, which is wounded in the affray, shows them that the child really has a heart of gold, and the story ends with a lesson well learned and the animals and now inanimate objects looking forward to a safer and more peaceful existence.

And, no doubt, so does the child's mother.

This little tale gives but a small clue to the ingenious and brilliant orchestration of Ravel, and of the equally skilful handling by the players. There are ten vocalists representing the various characters, some of whom double and triple their parts, while the choir effectively supplies the vocal "noises off". It is all very charming, and in the absence of any other recording for comparison, must be voted a huge success.

And, in fact, Ansermet and his players are sufficiently well reputed in music of this kind to be accepted without demur.

Those whose special interest lies in these fields will be completely delighted. Others will find the fascinating music easy to take. Recording and pressing are first rate.

BACH—Tocatas in E minor and d minor, Praeludium, Fugue and Allegro in E flat major. Played by Fernando Valenti, Harpsichord. NIXA LLP8048.

This is a superb example of harpsichord playing and recording.

The instrument is a big one, with four sets of strings and two keyboards, capable of the full range of harpsichord tone color. It has a big, full tone, which will amaze you if you have imagined the venerable instrument to be a tinkling affair of no real stature.

Valenti is one of the world's leading harpsichordists, although scarcely 30 years old, and this disc will illustrate his mastery.

It has added value because we rarely hear works of this nature played at all, and I am sure there is not an instrument in Australia which can match this one. If there is, I have never heard it.

The recording is extremely forward, although not so much as to show up mechanical noises, which often spoil microphone performances. Perhaps the instrument has been specially adjusted to reduce them, for they are virtually inaudible. If you listen carefully you can hear the action of the dampers operating on separate sets of strings.

The Bach is youthful and vigorous, cleanly played, with free use of registrations, although to the average ear the sound might become a little oppressive at times. That will depend on whether you are interested in harpsichord or not.

If you are, you'll be delighted with this record.

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for inclusion in the December issue, but it is far too good to be overlooked.

It is a collection of songs and carols, mostly with a Chirstmas flavor, but so beautifully sung and recorded as to be acceptable at any time.

Some are sung unaccompanied by a children's choir, others by a mixed choir with organ or orchestra.

This variety in itself gives added interest, and avoids any monotony which may have occurred with such a large collection on one disc.

None of the numbers is particularly forward in recording—on the other hand they have a far-away atmosphere by no means unappropriate and with a charm of its own. The arrangements are traditional and the performances crystal clear against a silent background.

Two versions of Silent Night, O Tannenbaum, and Von Himmel Hoch are sung as beautifully as one could desire.

Don't overlook it, just because Christmas is over.

MOZART — Sinfonia Concertante in E Flat, K.297B; Serenade, Eine Kleine Nachtmusik, K.525. Played by the Philharmonia Orchestra with Sidney Sutcliffe (oboe), Bernard Walton (clarinet), Cecil James (bassoon), and Dennis Brain (horn). Conducted by Herbert von Karajan. Columbia 330CX1178.

Smooth and beautiful playing of the Concertante made it for me one of the most rewarding records of the month.

This is one of Mozart's works which we couldn't do without, even if at times we might imagine a few minor works could be put away without a major loss.

Not only is it lovely to hear, but it has an inner grace that reflects the rare mind of the man who wrote it.

It is played with grace and sincerity. You will, I am sure, feel that everyone participating in the performance understands and loves the music.

All three movements are of even quality but you will probably pick the Adagio for special mention. The soloists balance well with the orchestra which plays with typical Philharmonia quality.

The addition of Eine Kleine Nachtmusik, possibly Mozart's most popular work, adds extra weight to the claims of the disc. It is another round, gracious performance, quite free from any tricks either of performance or of sound. Slight groove echo is to be heard on both sides and may have contributed some heaviness to massed sound.

Unfortunately there were a few blemishes on my disc, which may not be common to the whole batch, and they are not serious enough to spoil it.

RECITAL OF DRAMA AND POETRY — by Dame Sybil Thorndike and Sir Lewis Casson, recorded in Australia. Festival CFR10-749.

Here is a unique memento of these two famous stage figures who were recently playing in Australia.

Their offerings are varied enough and, in fact, include material of a type which the average theatre-goer is not likely to have heard in the flesh.

Of them, I thought Sybil Thorndike's performance in the Trial Of Queen Katherine the best. This she gave with a force, dignity and passion quite remarkable for a woman of her age. Her surplus years were shed for the occasion by sheer vitality of the spirit.

The recording is fresh and forward—it has captured both voices without fear or favor. Peaky pick-ups might show out with prominent sibilants, but wide range equipment, even with an AES curve, will put them in their place.

The surface noise is quite inaudible, and as a local effort I highly commend it.

MAHLER—Symphony No. 1 in D major. Played by the Israel Philharmonic Orchestra conducted by Paul Kletzki for Columbia, 33CX1207, and by the Vienna Philharmonic Orchestra,.. conducted by Rafael Kubelik for Decca, LXTA-2973.

"Gustav Mahler's D Major Symphony began his great series of symphonic works—those naif, vulgar, herzig, huge, searching, world-containing masterpieces, shapeless as the plays of Shakespeare, trembling on the abyss of the modern world, imbued with the Language of Thomas Mann and the soul of Kafka.

"The voice of Mahler is at bottom a romantic voice. The things his imagination responded to were things of nature, of the folk spirit and often the dark night of the soul. His intention in music was always to wear his heart upon his sleeve, and this he did without overflowing the forms of the symphony. His grandness of conception certainly developed and expanded those forms and filled them with a breadth that comes from Beethoven, a melodic flow surely inherited from Schubert, and a daring in instrumentation, much of which he owed to Berlioz."

The above comes from the Columbia jacket, and it's not a bad introduction to a work which in later years Mahler called the "Titan" Symphony.

BOTH ARE GOOD

Both these versions are good. I would choose Decca's, I think, because I liked its more vivid recording and its stronger highlights. There is some terrific playing in it.

The Columbia is much quieter all round, and its quiet passages, particularly in the second movement, fade almost into inaudibility. Decca makes much more of the centre section—rather a relief from an otherwise rather drawn-out affair. It has, however, a decided drawback through its break for a turnover.

This preference for the Decca may not be shared by some, who may legitimately be charmed by Columbia's more mellowed approach. It is just as good a record in its own way.

Both are well balanced technically, with plenty of atmosphere and air about them. Lack of space would completely ruin this big-sounding work.

Decca has the wider range and the crisper attack. It might even over-exploit these things on occasions. Surfaces are good, the Decca plays well with the Decca curve, and the Columbia with the EMI.

As a note—keep your eye on this Israel orchestra. It's all right.

LALO—Symphonie Espagnole Opus 21. RAVEL—Tzigane. CHAUSSON—Poeme Opus 25. Played by Arthur Grimiaux with the Orchestra Lameureux conducted by Jean Fournet. Philips A 00228L.

The Lalo is a piece which always gets me in. Its rhythm, color, and wistful tunes tug at the heartstrings of anyone with the slightest romance left in his system. Often overlooked by highbrows, it is firm in the repetoire of ordinary mortals who just like lovely music.

Its fiery and brilliant passages are a test for any violinist, and it was in fact written for the Spanish virtuoso Sarasate. It calls for a broad, flowing tone, confident bowing and an elan to build and preserve its Spanish folk-song flavor.

Arthur Grimiaux has all these, and if he isn't as wispy in spots as Campoli's effort for Decca, he has a more solid tone and a surer bow.

His orchestral backing isn't quite as convincing as Campoli's. I'd peg them fairly evenly although of different flavor, with perhaps Grimiaux a nose in front.

He has the advantage of two beautifully played selections on the reverse side in nice contrast with the Lalo. Of the two I liked the Chausson best—the Ravel doesn't convince me greatly although it has characteristic brilliant color.

In the Lalo, the Intermezzo is omitted, but Campoli includes it. The surface is good, but the orchestra sounds a bit tubby and small in size. The surface is OK, and the jacket design a striking one.

TCHAIKOWSKY—Nutcracker Suite Opus 71a. Played by the Vienna Symphony Orchestra conducted by Rudolf Moralt. Philips S06050R.

A pleasant, straightforward performance which, together with the fact that it is complete on a single 10in side, make it quite attractive.

It cannot match Mercury's full length version for wide range sound, but obviously it wasn't meant to. Nor of course is it complete. It is the arrangement well known to listeners ever since the Philadelphia Orchestra recorded it nearly 30 years ago.

It has plenty of weight, good rounded sound and a reasonable surface.

BRAHMS—Quartet No. 1 in C minor Opus 51 No. 1; DVORAK—Quintet No. 3 in E flat major Opus 97. Played by the Budapest Quartet with Milton Katims second viola in the Dvorak. Philips A01151L.

At last I am able to welcome another record by the Budapest players made in the Washington Library of Congress, where there is a famous set of Stradivarius instruments which are not allowed to leave the premises.

The players and the recording engineers had to work in the library.

I don't know that the instrumental tone is as striking here as it was on the first record. But then they played Mozart, and the air was less complicated and the opportunities for listening more intimate.

The sound on both these works masses more heavily, and perhaps that has something to do with it.

At the same time it's an extremely

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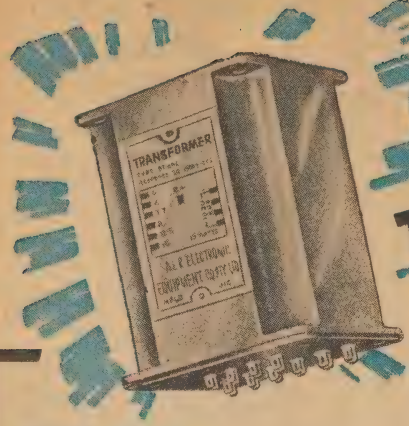

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Prim.: 5000, 3000 ohms P.P.
Sec.: 500 250, 166, 125 and 100 ohms.

TYPE 897 — 15 watts.
Prim.: 10,000, 8000 ohms P.P.
Sec.: 500, 250, 166, 125 and 100 ohms.

TYPE 896 — 15 watts. Prim.: 10,000, 8000 ohms P.P.
Sec.: 15, 12.5, 8, 3.7 and 2 ohms.

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TYPE 870 — 6 watts.
Prim.: 10,000 ohms P.P.
Sec.: 2 or 8 ohms.
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TYPE 871 — 12 watts.
Prim.: 10,000 ohms P.P.
Sec.: 2 or 8 ohms.

TYPE 872 — 12 watts.
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TYPE 2505 —12 watts.
Prim.: 6000 ohms C.T.
Sec.: As below.
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Type 2505-8 for 2 or 8 ohms Sec.
Type 2505-15 for 3.7 or 15 ohms Sec.

ULTRA LINEAR OUTPUT

TYPE 931-15: 20 watts.
Prim.: 4500 ohms P.P.
Sec.: 3.7 or 15 ohms.
Resp.:10,-60,000 cps.
Valve: EL37, KT66. 6L6, etc.
19% Screen Taps.

TYPE 931-8: 20 watts.
Prim.: as 931-15.
Sec.: 2 or 8 ohms.
Resp.: As 931-15.
Valves: As 931-15.
19% Screen Taps.

TYPE 921-15: 20 watts.
Prim.: 6600 ohms P.P.
Sec.: 3.7 or 15 ohms.
Resp.: 10-60,000 cps.
Valves: 807, KT66, etc.
19% Screen Taps.

TYPE 921-8: 20 watts.
Prim.: As for 921-15.
Sec.: 2 or 8 ohms.
Resp.: As 921-15.
Valves: As for 921-15.
19% Screen Taps.

TYPE 916-15: 12 watts.
Prim.: 8500 ohms P.P.
Sec.: 3.7 or 15 ohms.
Resp.: 10-50,000 cps.
Valves: 6BW6, 6V6, KT61, etc.
19% Screen Taps.

TYPE 916-8: 12 watts.
Prim.: As 916-15. Sec.: 2 or 8 ohms .Resp.: As 916-15.
Valves: As 916-15.
19% Screen Taps.

TYPE 949: 12 watts.
Prim.: 8000 ohms P.P. Sec : 2, 8, 12.5 and 15 ohms.
Resp.: 10-50,000 cps. Valves: 6V6, 6BW6, KT61, KL84, etc.
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A. & R. ELECTRONIC EQUIPMENT PTY. LTD. MELBOURNE, VIC.

fine disc. The Budapest players are essentially a serious-minded combination, and in the Allegretto of the Brahms, for instance, a lighter touch might have accentuated the contrast the movement was intended to provide.

But it is a beautiful performance, and not one you are likely to completely absorb for some time.

The Dvorak quintet, which the composer wrote within a month, is an extremely lovely work, and couples well with the Brahms.

As a recording the sound is smooth without being brilliant, it has a glow about it far from the realms of Hi-fi but easy to play and very easy to listen to. The inaudible surface is not the least of its virtues.

A disc you can buy with confidence —it's hard to see how you could be disappointed.

BEETHOVEN—Sonata No. 14 in C Sharp Minor Opus 27 No. 2 (Moonlight); Sonata No. 23 in F Minor Opus 57 (Appassionata). Played by Hannes Kann. Nixa MLPY-44.

Two such good performances of Beethoven sonatas on a single 10in record must be extremely attractive to the record buyer.

The pianist is somewhat theatrical in his approach. He makes the most of dramatic changes of pace and power, he searches through the part for each hand for a new effect or an enlightening emphasis.

Often he succeeded very well, particularly in the second movement of the Appassionata which I thought good enough to compare with anything I have heard. Whatever is done is done with restraint, a quality which justifies many points of view.

Piano tone is quite good, and the surface noise isn't prominent enough to affect the end result.

I liked it.

BIG THINGS AHEAD

The year, 1956, should see big things in the record world.

In the first few months, the effect of several changed contracts should become evident, with more releases and new labels.

The Australian Record Co. is relinquishing the Capitol label to EMI, which has acquired an interest in the company in USA, and in its place has taken over the American Columbia contract from Philips. It has big plans to exploit the new catalogue, in addition to its other wide recording activities.

Nixa plans to issue both the Cook and Urania records under their own names—both these have to date appeared as Nixas and have used imported stampers. From now on, Cook and Urania will be cut here from imported tapes. Nixa records will continue as heretofore.

Radiola is nearly ready to release its first Victor records from the RCA catalogue, and undoubtedly this will contain a large number of 45 extended play records as well as standard LP types by world-famous artists.

Festival has publicly denied a rumor that it has been taken over by EMI. The manager, Mr. Chalingsworth, says that EMI has not approached his company, nor has Festival approached EMI.

Philips is planning a huge release of its special Mozart Jubilee edition, and proposes to issue during the year about 150 separate items such as concertos, sonatas, vocal works, and so on with a list of titles and feature performers occupying several typewritten pages, all in addition to its normal output of other composers.

This is the biggest venture of its kind ever attempted, and with the reputation Philips has built up for high quality performances and pressings, music-lovers can look forward to some fine discs.

The complete issue is under the supervision of Professor Bernhard Paumgartner, president of the "Mozarteum" State Musical Academy, Salzburg.

SILICON POWER RECTIFIERS

(Continued from Page 23)

washers on a 1/8in thick aluminum chassis 6 inches square reduces the ratings to one-half. The thermal resistance of the bracket is 6 deg per watt, and that of the chassis 4 deg per watt. However, when maximum power output is required it is usually better to design a thermal path and heat sink best suited to the application.

The structure in degrees per watt is added to the thermal resistance of the rectifiers, and from this the permissible power rating is obtained for an allowed junction temperature rise to 150C.

Assembled rectifiers are measured for direct current specifications and temperature-tested. It seemed desirable to set up a load test which could regularly be used as a production test on completed rectifiers. However, even at present production rates, simple load resistors would absorb considerable power, all of which would be dissipated as heat.

A simulated load test has been developed with a synchronous switch operating from the 60-cycle power line. During half of the 60-cycle alternating current, forward voltage is supplied to the rectifier under test as shown in Fig. 9, from a low-voltage high-current transformer, and the average load current is measured on an ammeter.

INVERSE VOLTAGE

During the second half-cycle, this forward transformer is switched off and inverse voltage is applied through the same switch from a high-voltage, low-current transformer. The inverse characteristic is generally observed on an oscilloscope, although it could readily be measured on other test instruments.

As a result, the two transformers need supply only the internal losses of the rectifier, yet the load tester simulates a high-power resistive load of specified forward current and inverse voltage. Both these parameters can be separately adjusted by autotransformers and are set to the specifications of the various units of rectifiers in production.

In addition to these tests, some life tests have been in progress since the first units were manufactured over a year ago. Circuits using capacitive filters have been switched on and off every day.

A miniaturised rectifier employing a half-wave circuit with a 50 mfd. filter capacitor has been in operation for over a year, supplying 120mA output current. — ("Electronics".)

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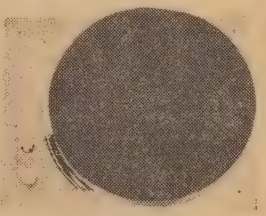

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SHORT-WAVE NOTES BY ART CUSHEN

COLOMBIAN CULTURAL STATION VERIFIES

Radio Sutatenza, in Colombia, a past favorite with the special Australasian transmission, has forwarded details about the present broadcasts.

THE station now uses the call signs of HJGC on 5075 Kc and HJGO on 3250 Kc. However, during earlier broadcasts the Saturday transmission had started 30 minutes earlier with English and used the call sign HJKJ on 5075 Kc.

This special service which enrolled many local listeners has since, unfortunately, been discontinued.

When a young Priest was assigned duty in the mountain community of Sutatenza, a pocket in a high valley of the Andes, he found his first task was to educate his charges.

The Priest, Joaquin Salcedo, thought of his youthful hobby of radio. As it was necessary to teach the fundamentals of school education to the illiterate peasant community he purchased three battery receivers and constructed a small 100-watt transmitter, which was housed in his study.

His educational broadcasts, begun in 1930, found many listeners, and before long the town built a new brick building to house a transmitter of 1000 watts.

By 1935 the Government of Colombia, had found that Radio Sutatenza had listeners in all parts of Colombia, and decided to help the station. With the added assistance of private donations its work was expanded and many more valleys in the Andes began their education by radio.

In the past few years a new 25,000 watt transmitter, the most powerful in Colombia has been installed and carries morning and evening lessons to some 18,000 communities of peasant groups in every niche of the Andes and for five hours offers music news and humour to the whole nation.

In 1953 only half of the 12-million population of Colombia could read or write, but this number is fast increasing because of Sutatenza's work. Even UNESCO experts have studied the station with the idea of adapting it to other countries.

The decision to leave the station at Sutatenza instead of Bogota, the Capital, has proved to be no small part of the success of the venture, as the station, situated on the farming community still maintains the ties with the folk to which the broadcasts are made, and has not assumed the style of the large city broadcasts.

A two storied white rectangular building, with a restful patio garden, houses modern studios, meeting rooms, and offices. Three transmitters, comprise the Accion Cultural Popular network, they are HJGP (1580) 500 watts on broadcast band and HJGC (5075) 25,000w, and HJGO (3250) 10,000w. Two other stations which relay the broadcasts are Radio Belencito HJGJ (1150) 1000w, and Emisora Filialen Bogota, HJCY (1500) 1000w.

The station on shortwave operates from 8.50 pm-1.40 pm.

The station, in verifying with a program booklet lists the address as Radio Accion Popular, Apartado Nacional 3262, Bogota, which is the main administrative office.

AUSTRIA OE139 ON 11 METRES

THE new Austrian Broadcasting Service has been testing in the 11 metre band to North America, transmission time is 5.00-6.00 pm using 20,000 watts on 25.945 Kc and the call sign OE139. A further report puts the test as 11 am-10 pm on this same frequency, and a weak signal has been heard here at 8 pm.

Another signal on this band is GSQ on 25.750 Kc. Radio Osterreich Vienna tests on OR138 on 25.615 Kc to South America at the same hour.

OE120 Innsbruck is at present inactive, but will return to the air very soon on 6000 Kc with increased power. The Rot-Weiss-Rot, Vienna, was handed back on July 27, 1955 to the Austrian Broadcasting System, by the US Information Service.

These notes are compiled by Arthur Cushen, 212 Earn Street, Invercargill, N.Z. All times are Eastern Australian Standard.

Test broadcasts from Vienna, using a 40,000w transmitter have been heard at 5 pm on the 5985 Kc frequency at fair strength. The complete schedule is, OE150 (5985) 5.00-7.00 pm, 11.00 pm-5.00 am, OE122 (7245) 1.00 am-noon weekdays, 11.00-noon Sundays. 7.30-10.30 pm daily, OE123 (9665) 5.00-8.00 am, OE136 (11,935) 12.30-2.00 pm, to 3.00 pm on Sundays, reports Deutsche Welle DX program.

THE Spanish National Radio at Madrid, which recently commenced broadcasts in the 41 metre band with 100,000 watts has added another two new outlets.

A new 25 metre frequency, which is announced as 12,000 Kc, but is actually 11,990 Kc, is used in the North American service, from 1.10 to 1.45 pm. This transmission is also carried on 9365 Kc, a channel which has been used for this service for many years. The transmission is in English and on 11,990 Kc is heard at good strength dispite some interference from the Chilian transmitted on 11,985 Kc.

The normal Home Service programme of Madrid is broadcast in the 50 metre band, on 5990 Kc and has been heard from 5.00 pm. The transmission is all in Spanish and includes a morning devotional service to 5.05 pm and then a musical program.

The signals are good, as the channel is generally clear from interference, and as this band at dusk favors short path reception from Europe, a reliable transmission for 30 minutes can be expected.

Both male and female announcers have been used, and the station uses the slogan "Radio Nacional Espana, Madrid".

FOR NEW SHORT-WAVE LISTENERS

WE frequently receive letters from new short-wave listening fans wishing to receive a particular overseas station. New Australians, especially, are often very keen to hear broadcasts from their former homeland.

Unfortunately, it is impossible to plan short-wave transmissions with the same ease as the local broadcast stations. To ensure that they have a reasonable chance of being heard it is necessary to make frequent changes in both the times and frequencies of the transmissions.

In these circumstances it is impossible to compile a permanent list of short-wave stations and the short-wave notes on this page are intended to provide a continuous coverage of those stations most likely to be heard in Australia.

If you wish to hear a particular station we suggest you write direct to the author of these notes or, better still, if you know the address, direct to the station concerned. Stations are generally only too happy to provide information on the current and probable future schedules on which they intend operating.

FLASHES FROM EVERYWHERE

BRITISH NORTH BORNEO which broadcasts over Radio Sabu located at Jesselton, has added an evening transmission on the 7237 Kc frequency, reports Radio Australia. In the past, as the station has only used the frequency for an afternoon transmission, the possibility of reception is now much brighter, as the station opens at 6.30 pm.

The full evening schedule of 6.30-10.00 pm includes broadcasts in English, Malay, Dunsun and Chinese. The station is operated by the Post and Telegraph, at Jesselton, and uses 250 watts. The afternoon schedule is 1.50-3.00 pm Monday, Wednesday and Friday on VS4S using 7237 Kc.

SYRIA'S Broadcasting Service now operates, omnidirectional in Arabic 3.00-5.00 pm 6165, 7145, 5.00-5.30 pm 7145, 9.30-11.00 pm on 7145, 9555, 1.00-4.00 am on 6165, 7145, 4.00-5.00 am 6165, 7145, 5.30-6.00 am 7145, 6.00-8.00 am on 7145. French on 5.30-8.00 pm and 11.00-midnight on 7145, English 8.00-9.30 pm on 7145.

Overseas transmissions are — to North Africa in Arabic 11.00-midnight on 11,915, 17,865. French 6.30-7.30 am and 7.30-9.30 am English on 9555 directed to Europe. To Central and South America 10.00 am-noon in Spanish, Portuguese and Arabic on 9555 and 11,915 Kc. All transmissions are on 20 Kw except when on 7145 Kc when the power is 7500 watts.

ROME'S transmission for Australia and New Zealand, which is broadcast daily has now reverted to the following frequencies for the Italian transmission 21,570, 17,805, 17,750, 11,905 and 9780 kilocycles, the broadcast being transmitted 4.50-5.45 pm. A broadcast in English from 7.00 to 7.35 pm and is on 21,570, 17,805 and 17,750 Kc only.

American Forces Korean Network which has for some time been heard with the relay of Vagabond on 6970 Kc has been logged by Len Collett Oamaru NZ, on the new channel of 2655 Kc. News is broadcast at 7.00 pm and the usual AFRS programs follow. Due to the low frequency and power, signals vary, and are not as reliable as HLKA Seoul, Korea on 2510 Kc.

RADIO NEW ZEALAND

TRANSMISSION TO AUSTRALIA

6.00am-4.00pm on ZL1 9 (11830).
4.15pm- close down on ZL2(9540).

TO PACIFIC ISLANDS

3.00-7.55am on ZL3(11780).
8.10am-12.45pm on ZL4(15280).
1.00-4.00pm on ZL3(11780).
4.15pm- close down on ZL7(6080).
Close down is at 8.45pm weekdays, 9.20pm Saturday and 8pm Sunday. News broadcasts are at 4.00am(BBC), 5.00am(BBC repeat), 6.00am(BBC), 10.33am(NZ news Monday to Friday), 4.30pm (BBC recording of 4pm session), 6.30pm(NZ News), 8.30pm (NZ NEWS Monday to Saturday inclusive for these two latter sessions). Reports are appreciated by the New Zealand Broadcasting Service, Short Wave Service, P.O. Box 2396, Wellington.

THE HAM BANDS WITH BILL MOORE

144 Mc "GOES UNDERGROUND" AT JENOLAN CAVES

Radio Amateurs have in the past co-operated with Technical Bodies and provided communication for their experiments. Their work during recent cave exploration is a typical example of the assistance often rendered.

ON the weekend December 3 and 4 members of the NSW VHF section co-operated with members of the Speleological Society and journeyed to the Jenolan Caves to test 144 Mc gear as to its suitability for communication during underground cave exploration. All attending were enthusiastic about the results obtained.

It was originally planned that a number of stations would combine in the relaying of messages from the underground "walkie" station to a base station half a mile from the cave.

As tests proved excellent contact was established direct from base to "walkie" station.

Base stations were manned by Harry Capthorne, VK2HL, and Ted Howard, VK2XX, located at the mouth of the cave while Vic Cole, VK2VC, deeper in the cave was John Thornthwaite, VK2ATO, while Bob Ridgley, VK2ZAR, with assistance operated the "walkie" equipment.

As mentioned previously contact from the base station to the underground station was maintained at all times and beams clearly showed the signal was arriving directly through the mountain. The tests demonstrated the value of radio for communication in cave exploration, much more convenient than the usual land-line equipment.

Two problems were met during the tests, the first, a snowfall in December which is extremely unusual and the second, the fact that the organiser Perc Healy, VK2APQ, was stuck in between caves at one stage of the proceedings.

SCOUT JAMBOREE

The Federal executive of the WIA have installed a radio station at Clifford Park, 25 miles east of Melbourne, where the Pan Pacific Scout Jamboree is being staged.

The station VK3WIA, official Federal callsign of the WIA, will operate on the 2 Mc band for international contacts and 7 and 3.5 Mc bands for VK contacts. The station will operate until January 7.

A special Pan Pacific Scout Jamboree 1955-56 callsign card is being printed in color.

QSL cards will be forwarded to all stations contacting VK3WIA and amateurs are requested to listen out for the official Federal station.

Two 500-watt transmitters are available at VK3WIA and it is hoped that a large proportion of the 15,000 scouts at the Jamboree will be able to speak over the air and perhaps acquire a personal interest in radio as a hobby.

ARRL SURVEY

A recent field organisation survey carried out by the ARRL provides an interesting insight into US amateur activity.

The typical US amateur uses 230 watts input and operates for approximately 7 hours per month. Amateurs support the following phases of operation in the percentages quoted: Traffic handling, 30 pc; Rag chewing, 30 pc; DX chasing, 7 pc and 18 pc spend their time constructing equipment.

The most popular contest is the Sweep Stakes (interstate contacts). Forty per cent of the amateurs operating, 30 pc are active in the National Field Day, 19 pc in the DX contest, and 9 pc in VHF contests.

The favorite band is 80 metres with 7 pc supporting operation on this band, while in second place is the 40 metre band with 15 pc support.

General occupancy of the bands is as follows:—160 metres 2 pc, 80—39 pc, 40—21 pc., 20—18 pc, 15—5 pc, 11—1 pc, 10—7 pc, 6—2 pc, 2 metres and above 7 pc.

Half of the operators generally use two favorite bands, very few amateurs use more than three bands.

Of considerable interest is the fact that 25 pc of the amateurs who were interviewed owned emergency power supplies for home emergency operation and 37 pc had mobile equipment installed in their cars. The latter fact gives an idea of the extensive mobile operation in the US.

Amateurs during the survey were asked whether they supported other hobbies and they nominated over 100 variations.

Thirty-seven per cent take photography as a second interest while others spend their spare time off the air on a vast number of hobbies varying from raising parakeets to skin diving.

CONGRATS. TO S.A.

Congratulations to the South Australian Division on winning the Remembrance Day contest for the second year in succession. The average score of the winning team was 746 points and the members were, VK5MS, VK5EN, VK5RF, VK5WO, VK5JN, and VK5GW.

The two outstanding individual scores recorded were those of VK5MS and VK3ATN who both tallied 1001 points, the first occasion that the 1000 mark has been exceeded.

Scores are rising as each contest passes and contestants have to work hard to be among the winners.

MEET DAVE DUFF

One of Australia's best known radio amateurs in the DX field is Dave Duff, VK2EO, of Sydney, who through the years, has built up a fine record especially in the DX contest field. In fact he has won more DX contests than any other VK amateur.

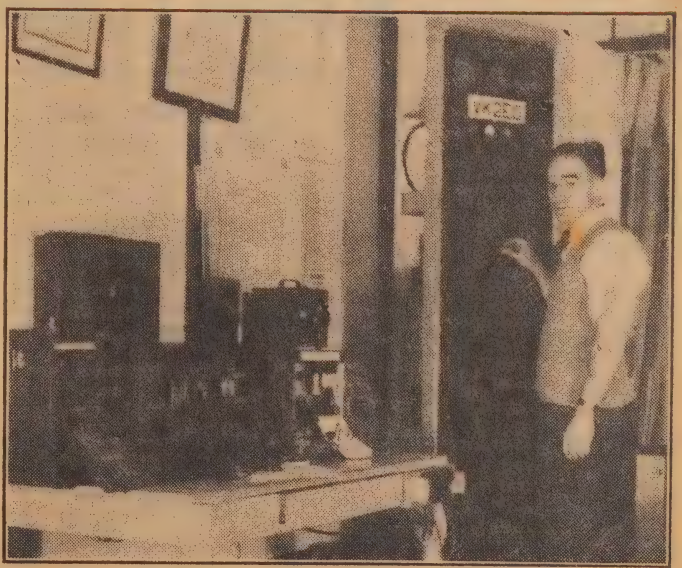
Dave was born in Geelong, Vic., just 45 years ago, and from the early 20's started experimenting with crystal sets and bright emitter valve circuits and a little later was second operator to a number of Victorian amateurs.

In 1926 Dave took the plunge and joined the navy in the wireless branch and from that time onward he has been tied up with radio. As time permitted he operated from ship and shore. Licensed first in 1931, calls VK2EO and VK3EO were both used, and each became very well known in the amateur bands, especially to Dave's many oversea friends.

After the war Dave obtained his discharge from the navy and joined the PMG's Department as an assistant radio inspector but since then has returned to the electronics industry.

VK2EO has always been an ardent WIA supporter and over the years has assisted in many ways. Has served as a councillor for a number of periods and was secretary of the NSW division for two years.

Currently an 813 and a four element beam are responsible for the 14 Mc signal heard from VK2EO and if you hear the rarer ones calling CQ Dave is always among the first answered. He is difficult



One of Australia's best known "hams", Dave Duff, and his station VK2EO. Out-of-doors, a cubical quad is taking shape to assist further in his quest for hard-to-get contacts.

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Tape Solder -- -- -- **1/9**

o compete with in the scramble for new ountries.

In the operating field Dave is really his element and prewar won both he VK/ZL and ARRL DX contests. ostwar he recorded first place in four RRL DX contests in a row (300,000 oints amassed in one contest) and was he winner of three VK/ZL DX contests, wo CQ contests, two European DX con-sts, a BERU senior contest and quite number of local affairs, DX fox hunts, c.

In recent years Dave has not been so ctive in contests, entering just to keep s hand in.

The zone award in the 1955 BERU enior contest fell to his key. DX asing is still a relaxation and the rrival of a rare DX QSL card creates ore than a little interest.

Dave is rather reticent about discuss-g his contest wins as the above list ould be increased if the full story would nfold. Currently a cubical quad for Mc is under way and it is anticipated at it will provide a bigger and better gnal from VK2EO—not too much bigger is hoped.

It is hard enough to create an im-ression through Dave's signal now.

IATIONAL FIELD DAY

The WIA's national field day will be eld this year on Sunday, Feburary 12, 56. The contest will run for 12 hours nd commences at 0900 hours EAST and ill continue until 2100 hours EAST.

A summary of the rules is as follows:—

The contest is limited to portable ations operating within the Common-ealth and its mandated territories. The put is restricted to 25 watts with the tenna connected. A special section is cluded for fixed stations working with rtable stations.

Power cannot be derived from private public mains for portable stations hich shall not be located closer than e miles from the home of the operator, nd shall not be situated in any occupied welling or building.

Apparatus cannot be set up earlier than hours prior to the commencement of e contest.

More than one operator may be used the operation of the portable station. ny number of transmitters may be erated but not simultaneously.

CW stations will call CQ NFD and lephony stations CQ national field day.

The contest is divided into four ctions: (a) Open. (b) CW. (c) Tele-ony. (d) Fixed stations. A separate g should be entered for operation in ch section.

Logs must be forwarded to the contest mmittee, through the divisional council r membership check in time to reach e Federal Contest Committee, Box 34K, GPO, Adelaide, not later than turday, February 25, 1956.

Logs must be accompanied with a scription of the equipment including T voltage to the final amplifier, tenna used and call signs of all erators.

Scoring: For the purpose of the field y the following constitute VK dis-cts: VK2, VK3, VK4, VK5 (South Aus-alia), VK5 (Northern Territory), VK6, K7, VK9.

Serial numbers must be exchanged and ll be in accordance with normal WIA ntest practice five figures for tele-ony and six figures for CW. In addition e QTH must be given in all cases.

OINT SCORING

Point scoring:—Portable stations: 1. ntacts with fixed stations within the mmonwealth—1 point. 2. For contacts th other portable stations within the me State—2 points. 3. For contacts with ations in Asia, Oceania, North America 3 points. 4. For contacts with stations other countries other than in 1, 2 or -5 points. 5. For Contacts with other rtable stations outside the competitor's n State—10 points.

Fixed Stations:—1. For contacts with rtable stations in the contest within same State—2 points. 2. For contacts th portable stations in the contest out-de the State—5 points.

Awards:—Certificates will be awarded to the outright winner in each section, namely open, phone and CW.

Certificates will also be awarded to the winners of each section in each State and to the fixed station in each State with the greatest number of points gained in contacting portable stations in the contest.

REPORT ON WOY WOY

The NSW Division's Woy Woy field day was held in late November and despite the record rainfall in Sydney on the previous day (six inches in places) the attendance exceeded the 150 mark. The weather fortunately kept fine for the event and a very representative gathering was present with members from the North Coast, Newcastle area, Blue Mountains, Sydney and south to Wollongong.

The usual long list of competitions and lucky numbers were conducted for the XYL's and OM's.

The main field events were the scramble, any band, any power, and run over 45 minutes. This was won by Bill Hall, VK2XT, of Newcastle, with 25 contacts, while another Hunter branch member Harold Whyte, VK2AHA, was in second place one contact behind. Don Pollard, VK2ASW, was in third place.

The other event the 144 Mc hidden transmitter search was also won by Newcastle amateurs with Ken Mitchel-hill VK2ANU, and Geoff Partridge, VK2VU, who found the transmitter in 20 minutes; Harold Whyte, VK2AHA, again filled second place. Bob Godsall, VK2ARG, was third. Harry Lapthorne VK2HL supplied and manned the hidden transmitter.

A special award was presented to the amateur who travelled the longest distance. It was Evelyn, W6NZP, who attended with her husband Frank. They are on a world tour and recently spent six months in South Africa. Frank is in the radio retail business in California, while Evelyn restricts her radio work to amateur operating. Both are extremely well informed on amateur organisation in the US and their impressions are very interesting.

They have been able to see much of VK amateur activity and will spend some months in Australia before moving onward.

The presentation of trophies and prizes was made by Hunter branch president Lionel Swain, VK2CS, and divisional vice-president Charlie Quinn, VK2AWQ.

The disposal committee produced many items that were soon snapped up by the amateurs present, committee members,. Alex Dan, VK2ABU, Allan Williams, VK2FH, and Harry Solomons, VK2AJZ, were busy distributing equipment.

The success of these days depends entirely on the efforts of a small band of workers and local amateur Cec Hardman, VK2KR, and his wife are always responsible for the major organisation. Johnnie Walker, VK2GA, another local, produces PA systems and other requirements each year.

Others active under the president Jim Corbin, VK2YC were on registration, Barry White, VK2AAB, Don Pollard, VK2ASW, and Stan Bourke, VK2EL. The swap table chief was Major Collett, VK2RU, refreshment dispenser, Rod Pike, VK2ACU, and Charlie Quinn, VK2AWQ, on varied duties.

Ruth and Val XYL's of VK2YC and VK2EL respectively, organsied the ladies' events and have been active on these days for years.

ANNUAL HAMFEST

The annual hamfest of the NSW division of the WIA will be held over the Australia Day weekend, January, 1956. The venue selected is the Ocean View Cabaret, Brighton, on the fore-shores of Botany Bay—a position ideal for all members of the family with baths, beach and picture show close by.

The opening session will be the normal monthly meeting held at Science House, Sydney, while the Saturday afternoon and evening sessions will be staged at the cabaret. A comprehensive program of lectures, competition and entertain-ment has been arranged.

All attending are ensured of a varied and entertaining weekend.

Sunday morning will see a business session held attended by country zone officers and representatives. Further details of the hamfest will be presented over VK2WI each Sunday morning.

★ ★ ★

The December meeting of the NSW VHF section was well supported. A varied program was arranged. Dr. Bob Black, VK2QZ, lectured on "Volts, Amps and the Man". Bob traced the history of research on electric shocks and pro-vided interesting data on the effects of shock and the degrees that were likely to prove fatal. A swap and auction sale of the members' surplus VHF gear was made and much equipment changed hands.

On each Monday evening members of the branch combine to transmit a message over a path from Newcastle to Tumut on the 144 Mc band.

The message in past relays has been originated by Doug Rogers, VK2ADS, Newcastle, to Adrian Rofe, VK2HE, in Sydney, to John Miller, VK2ANF, also in Sydney, to Hugo Stitt, VK2WK, in Forbes and finally to Keith Dodd, VK2ZAA, in Tumut. With the message travelling over 330 miles in three main hops, it affords a weekly check on pro-pagation conditions.

50 Mc OPENS

The 50 Mc band opened practically on schedule when late in November VK2 amateurs contacted VK3 and VK4. The New Zealand opening occurred just on a week later when ZL's appeared around midday on December 3.

The NSW VHF's section's November fox hunt on 144 Mc was won by Bob Winch, VK2OA. The fox John and Cec Thornthwaite, VK2ATO and VK2AZO, travelled 100 miles before being located. They moved in a wide arc from north to 50 miles west of Sydney in the Blue Mountains, where they were found by three parties.

A summary of the rules for the WAVE certificate is as follows:—

It is an award that can be won by VK amateurs with a reasonable amount of operating, not like some of the current overseas awards.

It is issued by the Nortown Amateur Radio Club on behalf of the Canadian Amateur Radio Operators' Association. Two cards are required from each of the following provinces:—Prince Edward Island, Nova Scotia, New Brunswick, Quebec, Ontario, Manitoba, Saskatchewan, Alberta and British Columbia.

The two cards must be from a different station contacted on a different band, a total of 18 cards.

Yukon and NWT QSL cards may be substituted for VE7 cards. All contacts must have been recorded after January 1, 1939.

QSL cards together with 50 cents to cover the cost of the certificate and postage should be forwarded to the Nortown Amateur Radio Club, PO Box 356, Adelaide Street Postal Station, Toronto, Ontario, Canada.

RSGB NOTES

The inaugural official RSGB broadcast on amateur bands covering society affairs was well received. For a number of years the RSGB had been negotiating with the GPO for permission to make similar broadcasts to the Sunday morn-ing WIA divisional transmissions. GB2RS operates each Sunday morning at 1100 hours on 3600 Kc/s and un-doubtedly the news bulletins will prove as popular as the Sunday morning sessions here.

144 Mc DX in Great Britain is still creating much interest with stations from as far east as Switzerland appearing. The main countries heard in G-land are Belgium, France and Germany.

On 14 and 21 Mc/s DX is still holding up well with varied stations audible. The former band from daybreak onward has provided some of the rarer countries. Some of the leading DX stations with their tallies around the 200 country mark have increased their totals by up to 10 countries.

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1P5	12/6	39/44	10/-
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2A6	12/6	78	12/6
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6AM6	17/6	1619	£1
6H6	7/6	1625	£1
6J6	15/-	1629	10/-
6J7G	9/6	2050	£1
6N7	10/-	4307A	10/-
6SK7	12/6	9001	8/6
6SL7	12/6	9003	12/6
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12V	1200V 200MA	6	10	0
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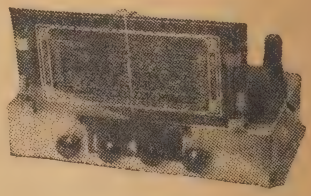

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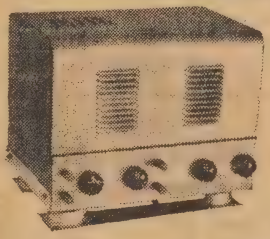

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LET'S BUY AN ARGUMENT

(Continued from Page 77)

1000 cycles down. This is well into the "middle" register.

To make the "boost" thus obtained effective on only the very low frequencies—say, below 200 cyces—the "tone control" capacitor would have to be so large and the control so extensive in its effect, that most users would merely regard it as a rather mysterious and redundant second volume control.

A true bass control circuit, on the other hand, only affects frequencies below about 300 cycles. Since our impression of loudness is mainly dependent on frequencies above this figure, operation of the bass control does not seem to make the general level very much louder or softer. It only adds to or takes away from the deep notes.

A proper bass boost circuit certainly does not operate primarily at the expense of the middle or higher frequencies. At the very most, its operation might cause the volume control setting to be modified a shade but that is all.

The point of our correspondent's question about treble boost is rather obscure. However, he seems to have at the back of his mind an idea that an amplifier normally operates with treble cut and that to reduce this cut is equivalent to applying boost elsewhere in the circuit.

The best that can be said is that he is half right. It is normal to use treble cut in varying amounts when playing back microgroove records, so that reducing the cut might be equivalent in effect to applying treble boost elsewhere in the circuit.

However, that doesn't help us when playing back 78 records or radio programs, where there is no preliminary boosting of the treble. A level response for playback is normal and, after having taken all the capacitors out of circuit, there is nothing left whereby treble boost can be obtained.

Of course, it might be argued that treble boost is seldom warranted and with this we might agree. That is why our latest Playmaster control units only have one boost position, not two, as originally provided.

It is sometimes useful where a particular record or program appears to have suffered some unnecessary loss on the way. Providing the said program is not distorted, a touch of treble boost can do much to restore its natural lustre.

BASS AND TREBLE

Boosting both bass and treble does not simply raise the volume, as our friend seems to imagine. With properly proportioned controls, it would begin to boost frequencies above about 2000 cycles and below about 200 cycles, leaving the middle register large unaffected.

It would have the effect of raising the apparent volume a little and may cause the user to retard the volume control slightly, thereby reducing the middle frequencies below their normal level.

Merely turning up the volume control would emphasise all frequencies equally, with a quite different effect on the reproduction.

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This book describes, with almost 100 circuits, the purposes of old and new developments used to improve the performance, safety and reliability of English commercial TV recievers. Sound rejection, a.g.c., interference limiters, c.r.t. circuits and power supplies are all dealt with. A useful reference for both engineer and amateur.

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Full details for building units which make up into complete local or long-range receivers, using any tube size from 3in to 16in. Operating and fault-finding data are included.

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Describes almost ever ytype of TV aerial, with full constructional and erection details. Antenna theory is covered simply and comprehensively, and the best type of aerials for various locations are fully discussed. An excellent book, indeed.

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Covers the construction, calibration and use o fa number of instruments designed for the TV engineer, serviceman, experimenter or amateur.

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SCIENCE MAKES NEW FABRICS

(Continued from Page 19)

the processes mentioned at the beginning of this article.

SANFORISING. This is a process whereby the cloth is treated so that it is preshrunk to allow only about 1 pc residual shrinkage to be left, or about one-third of an inch per yard.

A sample of the cloth is washed and the amount of shrinkage measured. The whole material is then put into a "compression" shrinkage machine which tenters the cloth by stretching sideways. The material is thus shortened in length. Tentering means gripping the cloth at the selvedge edges and pulling along a frame in steam.

SHRINKAGE

Excessive shrinkage in fabrics is often due to excessive tentering or stretching so that the cloth returns to its original size after laundering. If the cloth is stretched too much in the length it will shorten when washed.

TEBELISING. This is a term denoting that the fabric is crease resistant. There are other terms used according to the manufacturer.

The process consists in adding a chemical resin base to the material either during the dyeing process or spraying it on the surface afterwards.

PURITISED, TELOSORBENT, SANITISED. The material is treated with a germicide chemical which is odorless and non staining. This renders the material resistant to the odour of perspiration (BO) and sterile. Such materials are often used as linings for shoes to protect against athlete's foot.

BACONISED. The material is treated with stainless and odourless chemicals to render it resistant to moths.

ELLICOTED. This is a fire resistant process using chemicals such as carbonates and aluminium salts which melt and cover the cloth with a non-inflammable film.

If cloth is dipped in a solution of 30 pc boric acid and 70 pc borax it will be fireproofed. This washes out and the process must be repeated after each washing.

WATERPROOFING. There is a difference between making a fabric waterproof and water resistant. The degrees between are "shower-resistant, rain resistant, storm resistant and waterproof. Water repellent finishes consist of emulsions of wax, oils, insoluble metallic soaps, or compounds of ammonium hydroxide.

The latter compound combines with the fibre and the cloth feels softer.

Many of the effects seen on some types of fabric are obtained by chemical means.

The effect called crepe is produced in two ways. The tension of the threads in certain parts of the material can be varied during weaving thus producing a pulling effect and causing crepeing. In materials like the popular Seersucker the crepe effect is often produced by printing certain parts of the fabric with an alkali paste like caustic soda. When the material is washed the parts printed with the alkali will shrink while the unprinted parts will not.

SPECIAL EFFECTS

In certain pile fabrics designs may be obtained by using chemicals which eat out the pile while leaving the groundwork untouched. These designs can also be obtained by pressing or cutting. Brocaded velvets result from the chemical printing.

Certain "antique" velvets are produced by pressing down parts of the pile. This gives different light reflections.

Moireeing is a process of passing rayon or silk woven with heavy ribs, between heavy rollers which are provided with heavy irregular lines raised on the surface.

There are methods and processes too numerous to mention here which produce an endless variety of finishes and effects which all go toward providing the glamor not only in girls and women but also to the furnishing in the home.

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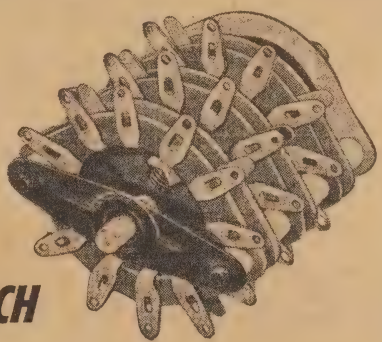

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COURSE IN TELEVISION

(Continued from Page 93)

capacitance filter circuit. The potential thus generated is ultimately used to trigger the frame oscillator.

We shall have more to say about this in a later article.

In figure 37, the first of the longer pulses begins halfway along a regular line, and therefore coincides with one of the additional half-line pulses.

On the alternate frames, the timing is altered slightly from that illustrated. The inter-frame blanking pulse and the first equalising pulse begin half-way along the last active line. At the same time, the series of long pulses move back a half-space so that they correspond with the start of a full line—not a half-line as illustrated.

In this way, the timing relationships between line and frame oscillators (as indicated in figure 35) can duly be satisfied.

Next month we plan to discuss the application of this video signal to a carrier and the nature of the complete signal, as radiated from a modern television station.

(To be continued)

TECHNICAL BOOKS OF INTEREST

SECOND THOUGHTS ON RADIO
HEORY by Cathode Ray. Published
y Iliffe and Sons Ltd., London.

To readers of Wireless World the
uthor needs no introduction; to
ose who have not previously read
s articles, this book will be a
leasant and informative introduc-
on.

His treatment of radio subjects is
at of a "down to earth" engineer,
ho chooses to rely to a minimum
mathematics. He has a happy
ack of extracting odd angles which
e missed in the conventional
pproach. His ability to phrase these
xplanations is also very good.

The range of subjects covered is
ry wide and as a whole they are
teresting and informative on the
bjects that they cover. However,
e book does not undertake to cover
e whole range of radio and funda-
entals.

The subjects treated are those
ndamentals which are all too often
ssed over by the technician and
gineer alike. This is the reason
r the "second thoughts" as applied
the title of this book.

It is very easy to read even though
ch subjects as cavity resonators,
e illusive "j" and Thevenin's
eorem are discussed. All the
apters in this book have previously
peared as articles in Wireless
orld.

This book can be recommended
a worthwhile addition to the
brary of anyone interested in the
bject of radio who wishes to
lve a little more deeply into the
ndamentals of everyday quantities
d circuits. (Our copy from the
blishers.)

★ ★ ★

TELEVISION RECEIVER SER-
ICING, VOLUME 2, by E. A. W.
preadbury. Distributed by Iliffe
d Sons Ltd., London. Stiff cover,
8 pages.

This is a companion publication
volume one of the same title and
hich was reviewed in these columns
few months ago. This covered
ne bases and their associated cir-
itry, while the current volume
als with all other aspects of a
odern receiver, from the servicing
gle.

The author assumes that the
ader is well acquainted with the
ual radio fundamentals and has
d practical experience in servicing
und receivers. The purpose of the
ok is to assist such readers to
onvert" to television servicing
th a minimum of trouble.

The following list of contents gives
me idea of the subjects covered:
ne Video Stage—Vision Interfer-
ence Suppression—The Vision Detec-
tor—Tuning Circuits—Multi-Chan-
nel Tuners—Vision AGC—The Sound
Channel—Power Supplies—Aerials
and Feeders — Reflections and
"Ghosting"— Circuit Alignment —
&c.

The text is profusely illustrated,
both with sections of circuits and
photographs of receiver screens to
show the effect on the picture of
various faults. There are also
photographs of time base patterns as
generated by the receiver and dis-
played on a CRO screen. In all there
are 161 diagrams and 15 photographs.

The chapter on circuit alignment
is particularly interesting in that it
describes various types of commer-
cial signal generators currently in
use overseas and which are begin-
ning to appear on the Australian
market. Wobbulators, marker pip
generators and similar devices are
explained in detail and photographs
are used to illustrate the type of
alignment patterns obtained from
them.

Although written for English con-
ditions and standards it should
nevertheless prove an extremely
valuable reference volume for those
who want to prepare themselves as
quickly as possible for the work
ahead. (Our copy from the pub-
lishers.)

★ ★ ★

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G.A.G. Ive. Stiff covers. 150 pages.
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copy from Technical Book and
Magazine Co., 295-299 Swanston St.,
Melbourne.

Considering the increasing use of
electronic devices, particularly photo-
cell equipment, in industry this book
should have ready sale. It should
appeal also to the "dabbler" and
others who like to fiddle with photo-
electric devices of all kinds.

It commences with a chapter on
light sensitive cells, describes the
various types, including the electron
multiplier, how they work, their
characteristics &c.

This is followed by a chapter on
valves and associated circuits, then
relays and auxiliary equipment.
This appears to be very practical
chapter dealing with the adjustment
of many well known types of relays.

Light projectors and their con-
struction and adjustment follow, to-
gether with methods of housing the
photocells. This is approached from
the commercial installation point of
view and contains much practical
and valuable data.

There is a chapter on setting
up commercial installations, typical
applications of photo-cell equipment
and, finally, on fault finding.

This should prove a very useful
handbook for anyone engaged in in-
dustrial electronics.

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Swanston St., Melbourne.

A large part of this book is de-
voted to the various types of test
equipment available for radio
servicing, their method of use and,
in some cases, details of how they
may be constructed. Although in-
tended mainly for the radio service-
man there is some mention of tele-
vision, along with constructional
details of a TV servicing CRO.

There is a chapter on tracing
sources of interference, and this
should prove very helpful to those
faced with this annoying problem.
Another on equipping a service work-
shop should provide a handy guide
to those commencing in this sphere.

Altogether a very useful refer-
ence for anyone embarking on a
career of radio servicing.

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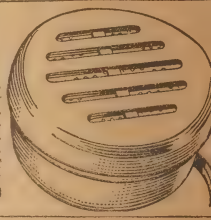

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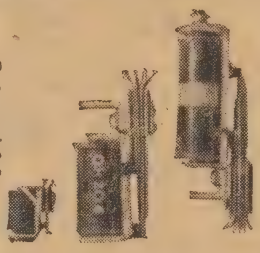

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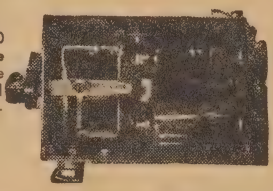

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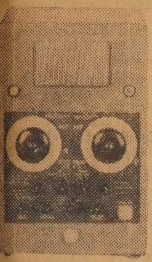
METROPOLITAN RADIO SUPPLIES

640 KING STREET, ST. PETERS, NSW. PHONE LA6087

479 PARRAMATTA ROAD, LEICHHARDT, NSW. PHONE LM3610

A.R.8 Communications Receivers

Converted for 240v. AC operation



including power-supply 9" x 7" ovaltone speaker

A.P.8 receivers are manufactured by A.W.A. and have a continuous coverage from 140 Kc to 20 Mc in six switched bands. Set contains 13 valves as follows: 3-6A8G, 4-6U7G, 2-6V6G, 1-6B8G, 1-6X5G, 1-6V4, and 1-6J7. Receiver speaker and power supply are fitted in attractive and durable plastic-covered instrument case which makes this unit complete and portable. On/off switch and tone control are also fitted.

£34/17/6

F.O.R.

NEW ENGLISH TAPE-DECKS

New English "Magnegraph" Tape Recorder Decks Made By Boosey & Hawks, London.

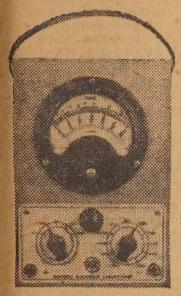
The deck which is completely assembled and wired is fitted with heavy duty motor and high fidelity heads. Two-track unit is supplied with circuit of amplifier, neon level indicator and oscillator coil.

£19'17'6

F.O.R.

COMPLETE AMPLIFIER FOR ABOVE CAN BE SUPPLIED BY MIRROFONE ELECTRONICS. 403 NEW CANTERBURY RD. DULWICH HILL. N.S.W. PHONE: LM1554.

NEW UNIVERSAL-MULTIMETER



Manufactured by Robinson Electronic Laboratories Incorporating 4½in World Famous American Weston Meter

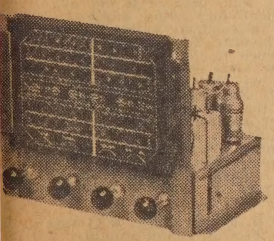
This high-grade instrument is fitted in a durable and attractive hammertone-finished case with self-contained batteries and supplied complete with test prods.

D. C. Ranges	A. C. Ranges	D. C Current Ranges	Resistance Ranges	Output Ranges	PRICE
0-12V	0-12V	0-1.5MA			£12/17/6
0-60V	0-60V	0-12MA	0-5,000 ohms	0-12V	Plus 12/6
0-300V	0-300V	0-60MA	0-50,000 ohms	0-60V	PACKING &
0-1,200V	0-1,200V	0-300MA	0-500,000 ohms	0-300V	POSTAGE

ALSO DECIBEL SCALE-18 to plus 5db.

NEW RADIOGRAM - CHASSIS KIT - SETS

5 VALVE DUAL WAVE



Complete kits of parts including 12in Magnavox or Jensen Speaker, five valves (1 6SA7, 1 6K7, 1 6SQ7, 1 6V6 and 1 6X5) and all other parts to the last nut and bolt to complete the five valve dual wave chassis illustrated.

These chassis when completed give excellent overseas, local and interstate reception as the coils supplied and intermediate transformers are high gain Permatune iron cored. Pick-up switch and volume control with A.C. switch supplied. Suitable for use with any crystal or high impedance magnetic pick-up.

LIST PRICE OF PARTS £25 __ __ SPECIAL PRICE £12/17/6

Please address all correspondence to 479 Parramatta Rd., Leichhardt, NSW.

METROPOLITAN RADIO SUPPLIES

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PHONE LM3610

ANSWERS TO CORRESPONDENTS

J.M.S. (Everton Park, Q.) wants to know if we can supply the circuit and other details of a certain commercial receiver.

A.: Sorry, J.M.S., but we have no files of commercial receivers, this being something we leave to the individual manufacturers. Frankly, we are hard put to it to find enough space to store all the general technical information which comes our way. We suggest that you contact the makers direct or their nearest representatives. Alternatively, reference to service manuals which are published annually may supply the circuit you require.

D.McG. (Willoughby, NSW) writes to suggest we describe a combination of control units which would allow him the use of either crystal, magnetic, or variable reluctance pickups as required.

A.: Many thanks for your letter D.McG., and the suggestions which it contains. You will be pleased to observe that your problem was already under consideration, at least, in part, when we received your letter. The result appears in the November issue in the form of a control unit for crystal pickups. We doubt if there is much demand for a system capable of handling several varieties of pickups, since most users settle for a particular type of pickup and seldom use more than one type at a time. The control unit described in the November issue is of such a design that a great many of the parts could also be used to build a more elaborate control unit suitable for one of the magnetic type pickups including the variable reluctance. There appears to be little point in worrying about the finer point of recording characteristics while using a crystal pickup with all its inherent limitations on smooth frequency response. The best that can be done with these is to approximate a selected response curve. In any case, the recording characteristic position is not nearly as chaotic as many people imagine. There is far less variation between the various curves for microgrooves than for the old 78 types. In addition, a standard curve has been selected and some of the major recording companies are using it. If it is selected as a standard playback curve by users, most remaining manufacturers would also accept it.

J.L.McP. (Brim, Vic.) wants to know if we can supply details of a shocking coil. He also appears to be in some strife with a five-valve battery circuit.

A.: Apart from the device you have already considered we have described nothing which might help you. These devices are similar to ignition coils but generate a lesser voltage. Considering the brief periods for which they are normally used the cost of battery operation is not normally a problem. It is impossible for us to say what was the cause of your burnt-out valve filaments without an actual examination of the set and some knowledge of the circuit you are using. However, provided the set is carefully wired and the circuit followed correctly, there should be no trouble of this sort. Unfortunately there is more to modifying the circuit than merely altering the filament connections, since the filament circuit is normally used to provide bias for the output stage and other means of securing this would have to be provided. Reference to some of the circuits already published in the magazine may help you grasp this idea.

L.K. (Mt. Colah, NSW) has a number of older type valves and wants to know where he can get a list comparing them with the modern miniature type valves in order that he may use them in current circuits.

A.: It is not possible to compare many of the modern valves with the older types, except in a general way, since they are seldom direct equivalents. It would seem better to use circuits designed for the older valves and we can probably help in this regard if you care to let us know the type of circuit which interests you. Details of the availability of circuits, &c., can be found in the panel on these pages.

J.M. (Nathalia, Vic.) is interested in wide range amplifiers of the CRO circuits and wants to know if we can recommend any text books on the subject.

A.: We are afraid we cannot help much in the way of text books J.M., except to suggest that you contact the various bookstalls in the capital cities and explain your requirements. Con-

version of our standard 5in Oscilloscc for wide range amplifiers was descrit in March and April, 1955.

H.R.H. (Tarado) wants to know if can supply details of overseas sho wave stations, particularly in France a Holland.

A.: We have no fixed list of the ty you require and which would be lit value in any case due to the almc continual shifting of station frequenc to cope with seasonal propagati chenges. We suggest you follow t Short Wave Notes in the back of ea issue of the magazine and you may a care to contact the author of these no whose name and address appears w the notes. The receivers you have, pa ticularly the AR8, should be quite ca able of receiving any overseas static that are strong enough to be worth hea ing. It seems most likely that yc failure to receive the stations is mair due to ignorance of the frequencies a times involved.

A.G.M. (Penola, SA) writes to the S viceman to tell of an interesting fa which developed in a piece of PA ge and which generated higher than norn voltage.

A.: Many thanks, A.G.M., and we w pass your letter on to the Servicem for his possible use at a later date. is certainly an interesting story a emphasises the need for care wh moderately high voltages are employ in the usual full wave circuit. As y suggest one would have to choose b tween the loss of the power transform or the rectifier and filter.

G.R.W. (Glen Innes, NSW) wants know if it is possible to operate a sta dard receiver from a 32-volt DC supp using a vibrator.

A.: Yes, G.R.W., commercial inverte are available to supply 240 volts a from 32 volts DC. Reference to a advertising pages will reveal some these firms. Unfortunately we ha never described such a device ourselv although we described a similar inver suitable for six or 12 volts (April, 195 Copies of this are available through t postal query service. Many thanks i your comments about the simple s and we will keep your suggestion mind.

F.L. (address given as NCL) says has a one-valve set which "when switch it on, it squeals. What's wrong

A.: We could not reply to your let direct, F.L., because it did not conta sufficient forwarding address. This quite a common failing by the wa the favorite trick being to omit a reference to the State in which a pa ticular town is situated. Your letter also too sketchy as regards techni details and we can only take a gu that the reaction circuit is not und proper control. We suggest that y have a look at some discussion of t subject in "A Simple Set for Beginne in the October, 1955, issue. If coils a your problem, a reprint "Coils For Sm Receivers" is available through the Query Service.

N.C.D. (North Collie, WA) says he built the G.P. Junior amplifier and ra it "a little beaut". He enters a pl however, for a description of a hig performance tuner for country listene with its own power supply.

A.: Thanks for your report, N.C. and we are glad to note that the a plifier met your particular need. We keep your request for a tuner in mi Maybe others would be interested such a proposition.

J.T.F. (Mt. Victoria, NSW) wants know if the control portion of the Pla Master No. 11 Amplifier can be used a separate control unit ahead of a Pla master No. 2.

A.: As you have probably already o served a control unit along these lir is described in the November issue a we would refer you to this for ex details.

The Radio, Television and Hobbies Query Service

All queries concerning our designs, to which a POSTAL REPLY is required must be accompanied by a postal note or stamps to the value of TWO SHILLINGS.

For the same fee, we will give advice by mail on radio matters, provided the information can be drawn from general knowledge. UNDER NO CIRCUMSTANCES, however, can we undertake to answer problems involving special research, modification to commercial equipment or the preparation of special circuits.

Whatever the subject matter, we must work on the principle that a letter is too involved if the reply takes more than 10 minutes of our time.

Queries not accompanied by the necessary fee will be answered FREE in the columns of the magazine and presented in such a way as to be of interest to other readers.

To those requiring only circuit reprints, &c., we will supply for TWO SHILLINGS diagrams and parts lists from our files covering up to three constructional projects. Scale blueprints showing the position of all holes and cutouts in standard chassis can be supplied for 5/-. These are available for nearly all our designs but please note they do NOT show wiring details.

Address your letters to The Technical Editor, RADIO, TELEVISION and HOBBIES, Box 2728C, GPO, Sydney.

Note that we do not deal in radio components. Price quotations and details of merchandise must be obtained direct from our advertisers.

J.H. (Perth WA) sends a circuit of an adio oscillator which generated very gh voltages until modified and also a ggested improvement for the con-ntional regenerative receiver.

A.: It is not really surprising that the illator "took off" as you describe, since e valve was operating without bias of y kind. In the circumstances and con-ering the HT voltage employed, it ould be quite easy for the valve to nerate audio voltages of the order you ggest. We are afraid the regenerative rcuit does not offer much hope of any provement over conventional arrange-nts. In any case the conventional feed-ck circuit has been retained and an tra feedback circuit merely added. ice the amount of feedback is always verned by the onset of oscillation there nothing to be gained by providing ditional feedback paths.

Also, there does not appear to be any al need for the germanium diode, uming that the alternative feedback twork was chosen. There appears to be ne confusion over the valve you wish substitute for the 6AE8 in the Short ave Converter (July 1955) since the 5 you mention is a power amplifier ntode and quite unsuitable for oper-on of this kind.

G.F. (Machans Beach, Q) has an ampli-r which is giving trouble. He has found t the plate and screen voltages of the t 6J7 are apparently low, while the thode voltage is over 100.

A.: Assuming that you are not refer-g to the phase changer G.F. we would ggest that the cathode resistor of this ve is at fault being either high or en circuit. In the latter event leakage the electrolytic would act as a high ue of resistance. Such a condition uld certainly upset the amplifiefir sen-vity. However, the voltage which can measured on the plate and screen of esistance coupled stage will be quite when using a conventional multiment ich will probably draw more current n the valve.

C.G. (Ararat, Vic.) wants to know if have ever published any data on tning arresters for buildings and lists various factors which he would like rified.

A.: Sorry C.G. but we have never pub-hed anything along these lines. As far we know it is usually regarded as ficient to provide an adequate con-tor from the top of the building, or htly above it, to earth. Provided this a reliable path it would appear to be that is necessary. However, for a lding of any size, you would be well ised to seek the advice of an architect, insurance company or some other body cerned with such matters.

D.J. (Christchurch, NZ) writes he has t the "Rambler" Portable which is able of extremely good distance re-tion even to 2FC Sydney, 1000 miles y. However, he says that distance ption is somewhat marred by a kground hiss for which he has eloped his own explanation.

.: Apparently your set is working emely well and the background hiss distant stations is quite normal par-larly as you are apparently relying the built-in aerial. Your theories n't accurate and are much more in-ved than need be. We may take the ortunity of discussing them in a re issue under the "Argument" mns.

L.C. (Darwin NT) writes to the viceman to describe some of the ponent problems which he encounters he tropics, particularly relating to the ker transformers. He also describes e of his experiences in the field con-ning projection lamps for 16 mm pro-ors and a strange defect which affect-a number of them.

: Many thanks for your letter C.L.C. we will pass it on to the Serviceman his possible comments. In the mean-it is interesting to hear of the blems which beset technicians in the ics and in isolated areas, also your roach to the problems. Keep up the l work.

C. (Waterloo, NSW) writes to us en-ng the circuit of a tester for electro-condensers.

: Many thanks for your letter T.C., we have filed your circuit for pos-e use in a future issue in the Reader t It section. We are always pleased to hear of the experiments that our readers carry out as we may be able to pass the information on to other inter-ested readers.

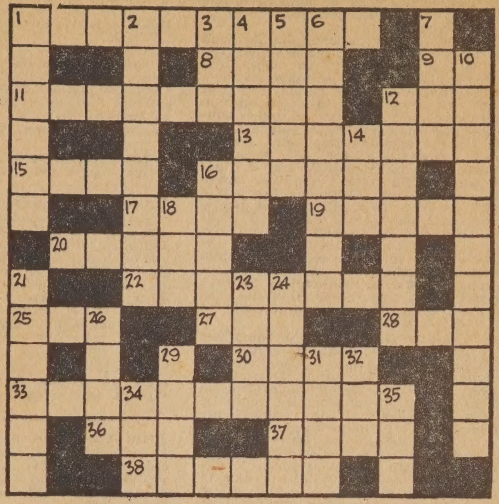
K.M. (Tamworth, NSW) writes to ask us to send him a circuit of a two-valve battery radio.

A.: As you will already have seen from the October issue of the magazine we have described such a radio to meet the constant demand that is made for this type of circuit.

D.M.E. (Lilydale, Vic.) writes to thank us for a previous reply and to list some new questions. He wants to know how to add a BFO unit to high selectivity IF channel featured in the October issue. Other suggestions are that we published a complete circuit of an electric organ before the series is completed and that we also describe a large communications receiver. With regard to the latter, D.M.E. is under the impression that we have never published anything along these lines.

A.: Fitting a BFO to this IF channel would be no different to fitting it to any other IF channel. In general, it simply requires a small oscillator working with-in one or two Kc of the IF and coupled to the IF channel by a small capacitor. Exact details of such circuitry can be found in circuits of communication re-ceivers described in past issues. Con-trary to your impression, D.M.E., quite a number of such receivers have been published, varying from three-valve to 11-valve types and covering the most generally used circuits. If you care to let us have details of your requirements we would be able to supply copies through the postal service. Many thanks for your comments regarding the electric organs. We can make no promises about a complete circuit or constructional de-tails. At present such information is a major job.

THE R. & H. CROSSWORD No. 21



ACROSS

1. Describing electron emission in a valve
8. To fit
9. Either
11. Apparent resistance
12. Employ
13. Glues
15. Confers a title
16. Receiving wire
17. Cuts a thread (pl.)
19. Organ controls.
20. A special skill.
22. Island in West Indies
25. Label
27. Logarithm (abbrev.)
28. Source of heat in solar system
30. To cut off
33. Compact communication equipment
36. French for king
37. Used in magnetic recording
38. To add moisture

DOWN

1. Three-element valve
2. Variable resistor
3. Mining town in Queensland (Mount . . .)
4. Units of weight
5. Better
6. Listed
7. Prefix meaning after
10. Opposing the flow of current (pl.)
14. Corrode
16. Calendar month
18. Atmosphere.
21. Natural interference
23. Facial organ
24. To kindle
26. Equipment
29. Large continent
31. Man's name
32. Vigor
34. Inclination of the head
35. Color

Solution and further crossword next month

Last Month's Solution

	A	U	T	O	D	Y	N	E			U			
	T		O		!		O		A	M	P	S		
	T	A	N	T	A	L	U	M		A		H		
S	E	M	I		C		N		O	G	L	E		
	N		C		A					N		L		
	U		T	E	T	E		N		E		L		
J	A	R	R	A	H		U	L	T	R	A			
	T		A	T	O	M		M			C			
	O		I		D	O	U	B	L	E	T			
T	R	I	N	D	E	R		E		M	I	D		
A		O		O		S	T	R	O	B	E			
P	E	N	T	O	D	E		E		E				
E		S		R				D	A	R	K			

ANSWERS TO CORRESPONDENTS

F. H. (Auckland, NZ) feels that some of our latest amplifier designs are too complicated and supports his view by some outline sketches of amplifiers and a tone control which he considers to be a good design.

A.: Perhaps there is something in what you say. If you prefer the simplest designs by all means stick to them. It is largely a matter for a personal decision. On the other hand such simple amplifiers cannot be expected to compete in absolute performance with amplifiers including full facilities. The simple variable treble and variable bass tone control cannot compensate for all recording characteristics for example, and the use of triodes in the voltage amplifier stages will result in high frequency losses due to Miller effect. This will only be partly compensated for by the degree of feedback which can be applied with stability.

A.J.D. (Fiskville via Ballan, Vic.) inquires in his recent letter, what effect a vented enclosure has on sound reproduction, if used in conjunction with a feedback amplifier. Some folk he has consulted state that it is preferable to use a flat baffle.

A.: Negative feedback in an amplifier has a twofold effect: firstly it reduces the harmonic distortion of the amplifier, and secondly it lowers the internal resistance of the amplifier, thereby providing a certain amount of loudspeaker damping. This second effect in turn reduces the tendency of the loudspeaker cone to resonate at a certain frequency. If such an amplifier is used in conjunction with a flat baffle, the output from the loudspeaker will not have undue peaks in the lower register. However, to obtain anything like adequate smooth bass response the baffle board has to be prohibitively large, and in practice is very rarely used. On the other hand, a vented enclosure is tuned, and has a resonant frequency of its own, so that the output could exhibit substantial peaks. However, these peaks can be reduced in turn by the internal padding so that, in the ultimate, the enclosure provides quite effective baffling in a small space.

A.C. (Mackay, Qld.) compliments us on what he considers to be an excellent job in producing Radio, TV and Hobbies and adds that he would like to see a radio for a bicycle described.

A.: We have no data on the bicycle radio you mention other than that you already have. Before such a set could be described in Radio, TV and Hobbies it would have to be constructed and developed in our laboratory in the same way as other project and, with many other ideas of more universal appeal awaiting such treatment, we do not think that this is likely to be done in the near future. If you decide to work on the idea yourself there are some observations we can make which may be of assistance. First of all, the output of most cycle generators is alternating current and as the frequency varies with the speed of the bicycle and the voltage regulation would be very poor the best solution may be to work from independant batteries. Another advantage of this is that the receiver would still be able to be operated with the bicycle stationary. The best solution then may be to adapt one of the standard battery circuits, regenerative or better still superhetrodyne, to suit your purpose. Our thanks for your appreciative remarks.

W.W.T. (Rabaul, NG) wants to know where he can obtain a list of short-wave stations which he should be able to receive in his locality.

A.: We have no general list available which would help you, but we suggest that the regular reports of short-wave stations which appear in the back of the magazine should be of considerable help. You might also care to write to the ABC for details of the various short-wave outlets for their regular programs. The address is 96 Market St. Sydney.

R.L.J. (Carnegie, Vic.) writes to ask the power output of the GP Junior described in the October, 1954, issue of the magazine and if it would drive three speakers?

A.: The power output would be approximately four watts. This could be used to drive three speakers but there is little point in doing so as it is possible to get one speaker to handle this amount of power without danger of overload.

WANTED TO BUY, SELL OR EXCHANG

Cost of Classified advertisements in this section is 2/- per line, approximately five words to a line. Closing date for February issue of Radio, Television and Hobbies is Wednesday, January 11.

SALE: Ideal for indoor portraits, two lamp stands with reflectors, telescopic 2ft to 6ft connected to hand switches giving series (half power) or parallel full power for photoflood £6/10/-. Airfreight 15/-. **C. Gordon, 57 Napier Crescent, Essendon, Vic.**

FOR SALE: Speaker cabinet bass. Reflex 12in large polished. **BW3315, Sydney.**

FOR SALE: Home-constructed tape-recorder, £35 including freight, amplifier, oscillator, power supply, 8in speaker all housed in compact cabinet; 2-speed deck, 2 good heads fast rewind, tape, reels and good mike thrown in; playback is clear and free from distortion, noise, hum and flutter, will accept 6 months' time payment, **T. R. Prior, 24 Wentworth St., Newstead, Laun., Tas.**

SELL: Back issues of R. & H. All copies in stock 4/- per copy incl. post. **T. Weir, 78 Gibson Ave., Padstow, N.S.W.** Prompt service quotes for quantity buying.

FOR SALE: A portable testing panel complete with power kit and carry case also quantity of books Radio and Television the lot £40. Apply **Mr. C. W. Worthington, 222 Marius Street, Tamworth, N.S.W.**

FOR SALE or exchange: HF receiver group 2A S.T.C. type A679—H. Good as new. **Harrie Haywood, 15 Whites Parade, St. Marys.**

FOR SALE: National H.R.O. Receiver 1.7—30 mcs £25. Collins Receiver coil turret RF units 3 valves 2—20mcs 4 bands £4. **J. MacIver, 21 Hurd Tce, Morningside, Bris.**

WANTED: 814 valve circuit AMR 300. **J. MacIver, 21 Hurd Tce, Morningside, Brisbane.**

FOR SALE: MODEL ENGINEERING SUPPLIES Castings, Blue Prints Catalogue 4/-. **Bolton, 72 King St., Sydney.**

FOR SALE: Two 70ft wireless masts, tubular, all fittings, ex-RAAF, £50, on rail Dubbo. **K. Bolton, 9 Nancarrow St., Dubbo.**

FOR SALE: Type 3 Mk 2 c/w spares, Handbook and builtin mod. Offers. **Rieper, Lewes Dve., E. Malvern, Vic.**

FOR SALE: Old German Piano, ivory keys. 7 octave, no insects, between £30 and £40. **Mrs. Burke, 28 Provincial St., Auburn.**

SELL: Printing. Special Offer:—100 Business or Visit Cards 30/-; 100 Letterheads, 30/-; 200 £2. Sent anywhere by mail. Do it now! **W. Hiley, 841 George St., Sydney.**

SELL: Now is the time to complete your collection of "Radio and Hobbies". Every issue available—several copies of each in stock right back to 1939. Only 4/- per copy incl. post anywhere. Special quote over four copies before 1950. Write now to **T. Weir, 73 Gibson Ave., Padstow, N.S.W.** for return mail service.

SELL: AT11 XMIT 3-5 5-8 8-15 Megs. 8 metered stages X tals 1-10 VFO x-RAAF. Offers, worth £100. 10 Band Eddystone, com. Rec. 40 KCS—3 megs Xtal con. TAI2C as new No. 11 trans as new. Ferguson Multi Tap mod X form 500-20,000 inst. chart SIG. Gen. A.W.A. Junior Int & Eat Mod. 400 cycle 6 band 50kcs — 27 meg. C.R.O. X form 2800V-1250V-4000V—2.5V Rebbecca Ind. unit 5BP1. complete. 2 x 4 MFD Cond. 1500V-5000V DC Chokes. S.C.R. 522 144 Megs. Selsyn Motors relays 813.866A 807. Host of Sundries books, &c. Offers, **Middleton, 40 Drake Ave., Caringbah.**

SELL: Rola 120 speaker new condit **£10. Woods, JF3562, Sydney.**

SELL: A few electric iron heat c brators and mains continuity tes brand new but paint damaged, tr price £14, our price in perfect work order £7. **Central Western Instrume Phillip Street, Orange.**

SELL: Soilless Culture experimental paratus, chemicals, motor, t switch etc., £30 complete, **16 Hodge Hurstville.**

SELL: Technical booksellers **56 Hu St., Sydney.** Newnes' TV Engine Pocket Book, 17/6, post 6d. Q's & Radio & Television 8/6, post 6d. Tel sion Circuits—Camm. 25/- post 9d. Pr Transistors & Crystal diodes 7/6, post Lists.

SELL: Crystal Mike and floor st Perfect order. £5. **XL3373.**

SELL: Motor B.S.R. 3-speed, very qu with GP20 P.U. 2-heads £10. Commu cations receiver £20. **JJ3873.**

SELL: Amplifier mike, pick-up, speak complete. Offer. Also sundry spks. c ponents. **Mrs. G. Myles, 9 Ken St., R**

SELL: G.E.C. variable reluctance mond stylus L.P. head, brand n **BL4120. Melb.**

SELL: A.R.C. test panel, uncomple Comprising multimeter signal tra and test oscillator with full book instr tions and throw-ins £50. **Cleary, 71 Road, Maroubra, NSW. FJ2003.**

SELL: Decca XMS pickup: Sapp heads, 78—LP: unused, complete mounted 3-speed motor, turntable. Bargain: Collins, 52 Fairview St., A cliffe, Sydney.

WANTED: Type 7R7 and 7Q7 tubes used in Type 3 Mark 2 Receiver, pay cash. **A. Giddings, Lancefield, Vi**

BOY: To learn all classes car r work from wiring and installation final testing. **Roadstar Car Radio, 93 John's Rd., Glebe, MW1702, MW3903.**

Complete novelette every week in Pocket Book all newsvendors

!

Vacuum Mounted Crystals

For general communication frequenci Greater activity guaranteed.

BRIGHT STAR RADIO

46 Eastgate St., Oakleigh, Vi UM3387.

Printed and published by Sungravure L at the registered office of the compa 60-70 Elizabeth Street, Sydney, NSW.